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LEVER (R. J. A. W.). **Cockchafer Pests of Cacao and other Crops.**—*Malay. agric. J.* **36** no. 2 pp. 89–113, 5 pls., 19 refs. Kuala Lumpur, 1953.

Severe damage is caused by Lamellicorn beetles to the leaves of cacao in Malaya, where the area under this crop has increased in recent years. The main species concerned are *Apogonia cribricollis* Burm., which has long been known [*cf. R.A.E.*, A **24** 105; **29** 512], and *A. expeditionis* Rits., which was formerly confused with it. These two Melolonthids are difficult to distinguish from each other and are treated together by the author. *A. laevicollis* Lansberge was also found on cacao but was commoner on *Trema orientalis*. Of the other species that attack cacao, the most injurious are the Rutelids, *Chaetadoretus cribratus* (White) and *Adoretus* (*Lepadoretus*) *compressus* (Weber). A key is given to the adults of the various Lamellicorns, and also one to certain other beetles that feed on cacao leaves, followed by notes on the damage caused. The distribution of *Apogonia* spp. is briefly discussed, and a list of plants attacked by *A. cribricollis*, including new records obtained in 1951–53, is given. In the laboratory, the development of *Apogonia* spp. from egg to adult averaged 93 days, and field-collected beetles survived for up to four months and in one case to almost six months when kept in the laboratory. They feed at night and shelter in the soil by day, and the larvae feed on roots or vegetable matter in the soil, though they have not been observed to attack the roots of cacao. When soil samples were taken in April–May in a field formerly used for pasture and newly planted with cacao, the *Apogonia* population was found to be about 43,000 per acre, the individuals round the cacao trees being mostly adults and those in the sod between the trees mostly larvae. The only parasite reared from the larvae was an unidentified species of *Tiphia*, larvae of which were found during the population counts feeding externally on the larvae of *Apogonia*.

Investigations showed that shelters consisting of palm fronds or similar material erected round cacao plants less than one year old excluded the beetles and favoured growth. In tests with various insecticides, the best control of adults and larvae in the soil was given by applying a suspension of 8 oz. BHC in 12 gals. water to the soil round the trees, at the rate of 2 pints per tree or 1 pint in the case of seedlings. Of the foliage sprays tested, lead arsenate at 0·4 per cent. gave the best results [*cf.* **29** 513–514]; it should be applied every four weeks, the concentration being increased to 0·6 per cent. in very wet weather. As lead arsenate alone does not control *Helopeltis theobromae* Miller, which attacks the pods and young shoots [*cf.* **29** 513], 0·2 per cent. DDT should be added to it when the trees are in bearing. No adhesive was found that would render DDT as tenacious as lead arsenate on the foliage in the wet climate of Malaya.

GORRINGE (B. S.). **Fumigation of agricultural Products. XI. Sorption of Mercury Vapour by Wheat.**—*J. Sci. Fd Agric.* **6** no. 12 pp. 791–799, 6 figs., 10 refs. London, 1955.

SOMADE (H. M. B.). **XII. Sorption of Methyl Bromide on Groundnuts.**—*T. c.* pp. 799–804, 2 graphs, 16 refs.

In the first of these parts of a series [*cf. R.A.E.*, A **43** 183], the author describes an apparatus for determining the concentration of mercury vapour in air, by the ultraviolet absorption method, that is much more sensitive than one previously described [**39** 54], being capable of detecting as little as 10^{-10} gm. mercury vapour in about 50 ml. air, and gives the results of tests with it. No sorption of mercury vapour on Pyrex glass vessels could

be detected by means of the apparatus. Experiments carried out at 11–35°C. [51·8–95°F.] with wheat containing 12 and 16 per cent. moisture and about 6 mg. mercury vapour per cu. metre showed that a rise in temperature resulted in some increase in the quantity sorbed in 24 hours, but that this was usually small at temperatures up to 30°C. [86°F.], and a test at a constant temperature of 25°C. [77°F.] with wheat containing 6–24 per cent. moisture showed that sorption increased considerably between 16 and 18 per cent. moisture content; above 18 per cent., all the mercury appeared to be irreversibly combined, whereas below this limit a certain amount was recovered by airing [*cf.* **39** 54].

Wheat that had been kept for two years in a desiccator over liquid mercury, but not in contact with it, gave off mercury vapour for at least 40 days when transferred to a vessel that was flushed with air once a day, and for 14 days when exposed to air as separate grains; wheat kept over mercury for six weeks and then exposed to air gave off mercury for six days. When kept in vessels that were not flushed with air, samples of the wheat that had been exposed to saturated mercury vapour for six weeks or two years reabsorbed mercury vapour as fast as they gave it off. In experiments in which columns of wheat in pipes were placed horizontally and mercury was introduced at one end, a steady state was reached quite soon and maintained for at least 21 days, showing that the amount of mercury diffusing along the column equalled that lost by sorption. The concentrations obtained after eight days at 25°C. were 5 mg. per cu. metre at 30 cm. and 0·25 mg. at 90 cm. from the source, the concentration–time products after five days being 600 and 30 mg. hr. per cu. metre, respectively. It is concluded that control of the eggs of *Calandra granaria* (L.) of a strain that had not become resistant to mercury vapour [*cf.* **41** 313] would be achieved if no part of the mass of wheat was more than 2 ft. from a source of vapour [*cf.* **34** 45], provided that air movement did not occur in the intergranular spaces. There appears to be little risk of the accumulation of dangerous concentrations of mercury in the free spaces of grain stores, in which leaks normally provide sufficient ventilation. The residues of combined mercury in the grain seem likely to occur in the form of insoluble and unmetabolisable sulphur compounds.

The second part contains the results of tests on the effect of fumigation with methyl bromide on groundnuts, made in England and in northern Nigeria, where groundnuts stored in heaps under tarpaulins in the rainy season are heavily infested by insect pests, particularly larvae of *Trogoderma granarium* Everts [*cf.* **40** 200]. To determine the effect of fumigation on viability and the amount of methyl bromide sorbed at different moisture contents, unshelled groundnuts containing about 5, 10 and 14·5 per cent. moisture were fumigated at doses of 10 and 30 mg. per litre for 24 hours at a temperature of 30°C., aired, shelled and sown in sand in the greenhouse or in soil in the open in England; groundnuts containing 5 per cent. moisture and fumigated at the higher rate were sown in Nigeria. The results showed no reduction in germination due to treatment except in groundnuts containing 14·5 per cent. moisture, which were affected to varying degrees by the lower dosage and completely prevented from germinating by the higher. The tip of the radicle was destroyed by doses high enough to kill the seed, but there was no evidence of combination of the gas with any major seed constituent. Groundnuts containing 5 per cent. moisture sorbed 377 parts per million methyl bromide without apparent damage, whereas 131 p.p.m. reduced the germination of those containing 14·5 per cent. moisture by about 60 per cent. Fumigation prevented visible growth of fungi on all the groundnuts and stimulated embryonic development and subsequent plant growth, but apparently did not affect the dry

weight of the plant at maturity. Data obtained in Nigeria showed that treatment influenced yields only in so far as it modified germination.

Fumigation of groundnuts separated into germ, cotyledons and husk with 10 and 30 mg. methyl bromide per litre resulted in the sorption of similar amounts of fumigant by all three components at the lower dosage but of nearly twice as much by the cotyledons and germ as by the husk at the higher, the husks sorbing the gas in proportion to its concentration. The amount sorbed rose somewhat as the relative humidity increased from 22·5 to 86·4 per cent. Over a wide range of relative humidities, the equilibrium moisture content of the husk was greater and that of the cotyledons less than that of the germ.

It is concluded that the moisture content of groundnuts that are to be fumigated with methyl bromide should not exceed 5 per cent. and that the dosage and circulation of the fumigant should be carefully controlled so that the concentration is maintained at about 30 mg. per litre throughout the mass. Under these conditions, there should be no adverse effects on germination, stand or yield.

Tirumala Rao (V.), David (A. L.) & Mohan Rao (K. R.). **Attempts at the Utilisation of *Chilocorus nigritus* Fab. (Coleoptera, Coccinellidae) in the Madras State.**—*Indian J. Ent.* **16** pt. 3 pp. 205–209, 11 refs. New Delhi, 1954.

The introduction of organic phosphorus insecticides, notably parathion, into southern India since 1951 has considerably improved control of Coccids, but reinfestation of treated crops from wild food-plants is inevitable unless natural enemies can be used to supplement chemical measures. Of several predacious Coccinellids available, the most suitable was considered to be *Chilocorus nigritus* (F.), which was numerous in colonies of *Parlatoria ziziphus* (Lucas) on *Citrus* in Coimbatore and of *Aspidiotus destructor* Sign. on coconut in the Northern Circars and has also been recorded from other scales in Madras.

When reared in the laboratory on *Pulvinaria maxima* Green in 1952 and 1953, *C. nigritus* increased rather slowly, however, giving rise to only 200 adult progeny per fortnight. The egg, larval and pupal stages lasted 5–6, 15–16 and 7–8 days, respectively, in October 1953, and one larva consumed nearly eight scales per day. The adults assembled in considerable numbers in colonies on the undersides of the leaves of banyan (*Ficus bengalensis*) in early summer and aestivated until July, and attempts to breed them in the laboratory in March–April or to use them for the control of *Coccus* (*Lecanium*) *viridis* (Green) on coffee at a hill station in summer were unsuccessful. Trial liberations at other seasons showed that *Chilocorus* was not effective alone but could usefully supplement chemical control. It gave encouraging results in preventing reinfestation of coconut by *A. destructor* and of *Citrus* by *Parlatoria ziziphus* and *Aonidiella aurantii* (Mask.) after spraying. Adults should be collected from banyan in summer and liberated a few days after insecticidal treatment of the plants with non-persistent sprays but not for a month after applications of parathion or BHC.

Janjua (N. A.). **Biology of the Melon Fly, *Myiopardalis pardalina* Big. (Trypetidae, Diptera), in Baluchistan.**—*Indian J. Ent.* **16** pt. 3 pp. 227–233, 6 figs., 21 refs. New Delhi, 1954.

Myiopardalis pardalina (Big.), of which all stages are described and the distribution and food-plants reviewed, has become increasingly important

as a pest of melon in Baluchistan in recent years, and its bionomics were therefore studied in 1947–49. It was found to be present throughout the hilly tracts at elevations of 2,500–6,000 ft. The eggs were deposited in the tissues of the young melon fruits just below the rind, and the larvae bored into the pulp and fed on the soft core and seeds. Pupation occurred in the soil at a depth of about two inches. The adults sheltered under leaves from the sun and cold winds, and the females laid an average of about 100 eggs each. The egg, larval and pupal stages lasted 3–5, 12–15 and 14–20 days, respectively, and there were about three generations between May and August, depending on the weather, the larvae of the last generation pupating in September, overwintering in the soil and giving rise to adults in May.

Sen (A. C.) & Prasad (D.). **Experiments with the new synthetic Insecticides for the Control of the Mango Hopper in Bihar.**—*Indian J. Ent.* **16** pt. 3 pp. 234–246, 13 refs. New Delhi, 1954.

The Jassids, *Idiocerus atkinsoni* Leth. and *I. clypealis* Leth., are the most important pests of mango in Bihar. The breeding period lasts about a month for both species, but begins 8–10 days earlier for *I. atkinsoni*, which is the more injurious, than for *I. clypealis*. Experiments on control [*cf. R.A.E.*, A **43** 111] were carried out in 1949–51. When DDT and BHC sprays and dusts were applied once in the last week of October and once during the flowering season, in the second week in February, against both species, the pre-bloom treatments greatly reduced the adult population during the breeding season, but both applications were desirable for effective control. Sprays were more effective than dusts, DDT was superior to BHC in a 0·125 per cent. spray on both occasions and a dust of 5 per cent. DDT was more effective than one of 5 per cent. BHC in the pre-bloom treatment.

Counts of nymphal populations after treatment with wettable-powder sprays of 0·15 per cent. γ BHC or 0·125 per cent. dieldrin or DDT showed that all gave 70–80 per cent. control in six days. Dieldrin was less effective in an emulsion spray, but aldrin appeared more effective in an emulsion, giving 70 per cent. control, than as a wettable powder. When mango panicles were sprayed with almost equal concentrations of DDT, dieldrin, BHC, aldrin and chlordane the mortality of newly hatched nymphs, put on them at two-day intervals, showed that the effectiveness of the first two insecticides began to decline after 10 and 8 days, respectively, and that of the remainder after four. After various insecticides had been applied to caged inflorescences infested with adults and eggs of *Idiocerus*, all the adults died in two days, but the eggs were unaffected, hatching in 2–5 days. Counts made after 15 days showed that 74·5 per cent. nymphal mortality was given by 0·125 per cent. wettable DDT and 27·6–45·6 per cent. by various sprays of BHC, aldrin, dieldrin, chlordane, parathion and pyrethrum, whereas when the same insecticides were applied to inflorescences infested with nymphs, 0·2 per cent. parathion gave over 90 per cent. mortality and 0·125 per cent. wettable DDT and BHC over 80 per cent. In a further test, sprays of 0·125 per cent. DDT and 0·1 per cent. BHC, alone or together, increased the mean nymphal mortality from 3·6 to over 80 per cent., with no significant difference between them, and in a comparison of concentrations, DDT resulted in about 82 per cent. mortality at 0·125 or 0·111 per cent., in 64 per cent. at 1 per cent. and in 5 per cent. at 0·09 per cent., as compared with 12 per cent. mortality for no treatment. DDT at 0·125 per cent. gave the best results in large-scale operations throughout Bihar, but treatment after the buds were open reduced the set of fruit.

Prasad (V. G.). *Neomaskellia bergii* **Sign.—another White-fly Pest of Sugarcane in Bihar.**—*Indian J. Ent.* **16** pt. 3 pp. 254–260, 11 figs., 4 refs. New Delhi, 1954.

Neomaskellia bergii (Sign.), which is a sporadic pest of sugar-cane in North Bihar, appeared in September 1948 on potted plants of the four main varieties grown in a cage house and was kept under observation until the end of the year. The females were attended by *Camponotus compressus* (F.) and *Crematogaster* sp. during oviposition and laid circular masses of 120–150 eggs on the leaves. The larvae fed on the leaf on which they hatched, the egg, larval and pupal stages lasted 2–3, 5–7 and 7–10 days, respectively, and the adults survived for 2–3 days. The life-cycle lasted 15–18 days in September and 18–25 days from October onwards, apparently varying more with the minimum than with the maximum temperature. *Eretmocerus delhiensis* Mani and an undescribed species of *Encarsia* parasitised 45 per cent. of the pupae and may be responsible for economic control in the field.

Hem Singh Pruthi & Bhatia (D. R.). **Further Observations on Aldrin as an anti-locust Insecticide.**—*Indian J. Ent.* **16** pt. 3 pp. 261–270, 4 refs. New Delhi, 1954.

The results are given of further investigations on the value of aldrin for control of *Schistocerca gregaria* (Forsk.), carried out in Rajasthan, India, on a larger scale than hitherto [*cf. R.A.E.*, A **42** 418]. The insecticide was available as a 60 per cent. solution, which was dissolved in enough kerosene to make its specific gravity equal to that of water and then diluted with water to the required strength for ground applications, and merely diluted with kerosene for application from aeroplanes, and also as an emulsion concentrate, which was used to some extent for ground applications. The rates of application were 1·44–4·7 oz. aldrin per acre from aircraft and about 3 oz. per acre from ground machines. Egg-beds, hopper bands, concentrations of newly emerged adults and resting swarms were sprayed in August and September, usually with excellent results, and the solution diluted with water was as effective as the normal kerosene solution, though much stirring was necessary in the spray tank. Extensive spraying of egg-beds resulted in the death of most of the newly hatched hoppers, whether by contact action or as a result of feeding on sprayed vegetation not being known. The average lethal doses for the hoppers were 0·5 oz. aldrin per acre for the first two instars and 1, 1·5 and 2 oz. for the third, fourth and fifth. The treatment apparently remained effective for about three weeks, since a spray of 2·7 oz. aldrin per acre applied on 3rd August to an egg-bed in which oviposition had occurred on 26th–27th July resulted in the death of all the hoppers, which hatched on 9th August, and also of most of a band of second-instar individuals that entered the area on 15th August, in spite of a fall of 3 ins. rain between 4th and 15th August. Similarly, treatment with 3 oz. aldrin per acre on 3rd–4th August killed all hoppers hatching on 20th–21st August, and applications at 2·73 oz. on 6th and 9th August caused some mortality of a mature swarm that settled in the area on 10th August and of fourth-instar hoppers that entered it on 18th August, respectively.

No deaths were reported among cattle and sheep grazing in areas sprayed with up to 7·4 oz. aldrin per acre, and grass (*Cynodon dactylon*) sprayed at rates of 5·33 and 8 oz. did not harm two sheep that grazed on it; one sheep died five days after the grass was sprayed with 10·66 oz. per acre, though it is not known whether death was due to aldrin, and treatment at this rate on 11th September had no ill effect on sheep that fed on the grass

for the next three months. No detrimental effect was observed on bajri [*Pennisetum typhoides*] sprayed with 3 oz. aldrin per acre on 10th August, or on other sprayed crops, but the possible effect on yield is not known.

KRISHNASWAMI (S.). **Studies on the insecticidal and adverse Effects of D.D.T. and B.H.C. on Vegetables.**—*Indian J. Ent.* **16** pt. 3 pp. 271–281, 1 ref. New Delhi, 1954.

Observations were made in Coimbatore in 1951 on the value of 1–3 applications of DDT or BHC as 5 per cent. dusts or 0·05 or 0·1 per cent. sprays for the control of pests on brinjal [*Solanum melongena*] and bhindi [*Hibiscus esculentus*] and on their effects on these plants and also on onion, radish and *Amarantus* growing between them. The DDT treatments were effective against *Empoasca devastans* Dist. on both brinjal and bhindi, the degree of control increasing with the number of applications. They showed considerable residual effect, which prevented breeding, whereas each application of BHC reduced the Cicadellid for about a week, after which the population increased rapidly. Neither DDT nor BHC gave any control of *Earias* sp. boring in the fruits of bhindi. All treatments practically eliminated larvae of *Epilachna dodecastigma* Muls. on brinjal in 24 hours and some if not all of them controlled the adults; more definite results were prevented by the mobility of the beetles. Mites (*Tetranychus* sp.) were more numerous on brinjal in plots treated with DDT than in those receiving BHC, and in those receiving 2–3 DDT treatments than in those receiving only one, probably owing to the destruction of their natural enemies. Yields were not affected significantly in either crop, possibly owing to extreme unevenness of stand.

The BHC treatments appeared to inhibit plant growth and cause scorching on brinjal, whereas DDT apparently stimulated growth. DDT caused rather less stimulation of bhindi, the growth of onion and radish was not affected by any treatment, and all caused a temporary slight yellowing of *Amarantus*. The odour and flavour of all crops treated with BHC was affected, the taint tending to intensify with the higher concentrations and more frequent applications; it was particularly intense and persistent in onions. DDT seemed to render the vegetables tasteless after cooking.

VENKATRAMAN (T. V.), VENKITASUBBAN (C. S.) & SELVARAJ (C. J.). **An interesting Dipterous Parasite of the Rhinoceros Palm Beetle** (*Oryctes rhinoceros*) **in India.**—*Indian J. Ent.* **16** pt. 3 p. 297, 1 ref. New Delhi, 1954.

The authors point out that a record in 1940 of *Sarcophaga fuscicauda* Böttcher parasitising *Rhynchophorus ferrugineus* (Ol.) on coconut in India [*R.A.E.*, A **29** 270] is erroneous, as the parasite was in fact reared from *Oryctes rhinoceros* (L.); the same Sarcophagid has recently been reared from adults of *O. rhinoceros* at Trichur.

PATEL (G. A.) & BHAT (M. V.). **Insecticidal Control of** *Pachydiplosis oryzae* **Mani.**—*Indian J. Ent.* **16** pt. 3 pp. 297–299. New Delhi, 1954.

In outbreak years, infestation of rice by *Pachydiplosis oryzae* (Wood-Mason), which causes the condition known as silver shoot, ranges up to 50 per cent. in the North Kanara District of Bombay Karnatak, and attempts since 1950 to control it with 0·5 per cent. wettable DDT, BHC or toxaphene, applied as seedling dips and as sprays during the growing season, proved

unsuccessful. Observations in 1953 showed that the eggs of the Cecidomyiid are often deposited on the surface of the water and that the newly hatched larvae may float for considerable periods before entering the shoots, so that a film of oil on the water in the rice-fields might give control. Also, sprays of chlordane or parathion gave encouraging results on potted plants in the laboratory. Tests were therefore made in the field in 1954. When applied five times at intervals of 7–10 days to transplanted rice that had become established, sprays of 1·6 lb. parathion (as an emulsion) and 8 lb. wettable chlordane per acre reduced the percentage infestation from 20·6 to 9·7 and 5·6, respectively, and 10 lb. mineral oil, saturated with dieldrin, per acre reduced it from 40·7 to 31·2. These reductions were significant, whereas those given by 3·8 oz. dieldrin and 2·5 oz. endrin (as emulsions) and 0·5 per cent. wettable DDT per acre were not. As infestation did not become significant until the time of the third spray or increase most rapidly until after the fourth, the number of applications might be reduced and their timing improved.

Mohammed Qadiruddin Khan & Murthy (D. V.). **A preliminary Note on a larval Parasite on the Rice Hispa.**—*Indian J. Ent.* **16** pt. 3 pp. 299–300, 4 refs. New Delhi, 1954.

Hispa armigera Ol. is one of the major pests of rice throughout India, causing an average loss of 20 per cent. of the yield. In Hyderabad, it is important on the two crops sown in June–July and January–February. It passes through six generations in these two crop seasons, and the second generation, in August, and the fifth, in February, cause severe damage, but are easily controlled by dusting with 5 per cent. BHC. An unidentified ectoparasite of the genus *Bracon* has been observed attacking the larvae of the Hispid, usually half- or full-grown examples, in Hyderabad since 1947. A parasitised larva is usually attacked by at least two larvae of the Braconid, which spin their cocoons inside the leaf-mine of the host. The pupal stage lasts about six days, the adults live for about five days, and the percentage parasitism observed varies from 15 to 82 per cent.

Pingale (S. V.). **Biological Control of some Stored Grain Pests by the Use of a Bug Predator, *Amphibolus venator* Klug.**—*Indian J. Ent.* **16** pt. 3 pp. 300–302, 1 ref. New Delhi, 1954.

As the Reduviid, *Amphibolus venator* (Klug), was observed destroying the larvae of *Trogoderma granarium* Everts, *Tribolium castaneum* (Hbst.) and *Corcyra cephalonica* (Stnt.) in grain stores in India, it was reared in the laboratory and tested for its effectiveness as a predator. It bred readily at temperatures of 70–90°F. and relative humidities of 40–70 per cent., but was killed by exposure to temperatures below 55° or above 105° for more than 24 hours. Under favourable conditions, the adults lived for 95·5 days and the females laid an average of 320 eggs each; survival and oviposition were greatest when Lepidopterous larvae were available as food. When the adults were confined with larvae of the three known prey species in the presence and absence of wheat, they could not reach the larvae in the grain and therefore died in a month without reproducing, whereas they survived and reproduced normally in the absence of wheat. The bugs fed freely when supplied with larvae of *Ephestia*, which usually leave the grain before pupating, and those of *Alphitobius diaperinus* (Panz.), *A. laevigatus* (F.) (*piceus* (Ol.)) and *Opatroides vicinus* (Fairm.), which develop mainly

outside it. In a practical test, 100 adults were released in a warehouse containing 1,000 bags (100 tons) of wheat infested by *E. cautella* (Wlk.) and *A. diaperinus*, and counts of adults of *Ephestia* on the walls and of *Alphitobius* on the floor (after removal of the bags) showed that the numbers of the former fell from 65·2 to 3 and of the latter from 212·5 to 23·5 per 25 sq. ft. in five months, while those in a warehouse kept free of the predator increased from 37 to 73·2 and from 174 to 281·2, respectively. Counts on the surface of the bags showed that the bug increased from very small numbers during the first month to 136·7 per 25 sq. ft. after five months. The grain suffered much less damage in the warehouse containing the predator.

Obenberger (J.). **Nový druh krasce z rodu** *Sphenoptera* **škůdce broskví v Pakistanu. A new Species of** *Sphenoptera*, **damaging the Peach-trees in Pakistan.**—*Acta ent. Mus. nat. Pragae* **29** (1953–54) no. 429 pp. 89–91. Prague, 1955.

Three languages are used in this paper, Czech for the introduction. English for the section dealing with the identity of the species of *Sphenoptera* concerned, and Latin for its description. It is described as *S. dad-khani*, sp.n., from specimens collected in Pakistan in 1950, is a serious pest of peach in north-western Pakistan and in India, and has previously been misidentified as *S. lafertei* Thoms. [*cf. R.A.E.*, A **31** 357].

Calcagnolo (G.) & Sauer (H. F. G.). **Efeito de modernos acaricidas no combate ao ácaro do algodoeiro,** *Eotetranychus telarius* **(L.).** [The Effect of modern Acaricides in the Control of *Tetranychus telarius* on Cotton.]—*Biológico* **21** no. 9 pp. 153–165, 6 refs. São Paulo, 1955.

Mites have since the introduction of organic insecticides become increasingly important on cotton in São Paulo and are now major pests of the crop in some areas. *Tetranychus* (*Eotetranychus*) *telarius* (L.) and *Tarsonemus latus* Banks, which have long been known locally as minor pests of cotton [*cf. R.A.E.*, A **28** 11, 12], are the main species, but others are also concerned. Control was at first obtained by the addition of 40 per cent. or more sulphur to the usual insecticidal dusts, but this measure has become progressively less effective.

Tests were therefore carried out in 1953–54 with four organic acaricides. Systox (50 per cent. diethyl 2-(ethylmercapto)ethyl thiophosphate), Aramite (15 per cent. wettable 2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite), Sulphenone (50 per cent. wettable p-chlorophenyl phenyl sulphone and related compounds) and Ovotran (50 per cent. wettable p-chlorophenyl p-chlorobenzenesulphonate). Cotton was sown in two series, on 10th October and 10th November, and given standard insecticidal treatments. Infestation by mites became evident 80–90 days after sowing, the species present being *Tetranychus telarius*, and sprays were applied on 22nd January to the cotton in the first series and on 25th March, after rain had delayed treatment until the mite population had passed its peak, to that in the second, the concentrations (expressed as active ingredient) being 0·1, 0·2 and 0·4 per cent. for Systox, 0·1, 0·15 and 0·18 per cent. for Aramite, 0·42, 0·7 and 0·98 per cent. for Sulphenone and 0·45, 0·6 and 0·9 per cent. for Ovotran and the rate of application about 9 gals. per acre for Systox and about 36 for the other materials. Counts of the mites were made on the lower surface of sample leaves before treatment and 48 hours after it, and

percentages of control were calculated according to the formula of Swingle & Snapp [**26** 82]. In the first series, these were 99·7–100 for Systox, 82–89·3 for Aramite, 81·2–91·3 for Sulphenone and 48·5, 92·3 and 81 for Ovotran at the three concentrations, respectively, and, in the second series, they were 95·5, 99·2 and 100 for Systox, 5·6, 73·2 and 80·2 for Aramite, 74·3, 38·3 and 83·7 for Sulphenone, and 80·4, 49·6 and 84 for Ovotran, respectively. The irregularity in the results of the second series is attributed to excessive rainfall. All materials except Sulphenone resulted in significant increases in the average yield of seed cotton in the first series, with no significant differences between them or between concentrations. The increase was greatest (29·5 per cent.) for Aramite. There were no increases in the second series, owing to the lateness of the treatment.

The good results given by Systox are attributed mainly to its systemic action, though it was also an effective ovicide. At 0·4 per cent., it retained its effectiveness for 25–30 days. As it is not known to what extent the residues are retained in the oil or cake from treated plants, preference is given to the other acaricides. These protected the crop for about 10 days, and it is thought that a second application 10 days after the first, and a third after a further 15–20 days, would afford complete freedom from infestation.

Box (H. E.). **A preliminary List of the Insects affecting Sugarcane in the Lesser Antilles and Trinidad.**—*Proc. 8th Congr. int. Soc. Sug. Cane Tech., B.W.I. 1953* pp. 549–553. Kingston, Jamaica, 1954.

Box (H. E.) & Guagliumi (P.). **The Insects affecting Sugarcane in Venezuela.**—*T. c.* pp. 553–559, 21 refs.

The first of these papers comprises a systematic list of the insects that feed on sugar-cane in the islands concerned, showing those in which they occur, other names under which they have been recorded, and their parasites and predators.

The second consists of a similar list, based largely on original observations and published as a supplement to an earlier work [*R.A.E.*, A **40** 388], of nearly 70 insects that feed on sugar-cane in Venezuela, with very brief notes on distribution, frequency and in some cases the damage caused and indications of those that are of economic importance.

Box (H. E.). **The Control of Sugar-cane Moth Borers** (*Diatraea*) **in Venezuela—a preliminary Account.**—*Trop. Agriculture* **30** no. 4–6 pp. 97–113, 8 refs. Trinidad, 1953.

The author reviews investigations leading to the release of introduced parasites against *Diatraea* spp. on sugar-cane in Venezuela and the results obtained by the end of 1951 [*cf. R.A.E.*, A **42** 213], records further liberations in 1952, and gives an account of observations made during a visit to the areas concerned in February 1953. Flourishing colonies of introduced races of *Paratheresia claripalpis* (Wulp) were found attacking *D. saccharalis* (F.) and occasionally *D. busckella busckella* Dyar & Heinr. on two estates in a part of the Tocuyo valley other than that in which liberations had been made and where the parasite had not previously been found. On one of them, parasitism of a scanty population of *D. saccharalis* was 19 per cent.

In the area in Aragua in which *Metagonistylum minense* Tns. was known to have become established [**42** 214], only a few dead-hearts could be found in February 1953, and five out of 15 larvae of *D. saccharalis* and 20 out of

25 of *D. rosa* Heinr. collected from them, were parasitised by it. The percentage of joints in mature canes showing external injury had been reduced from a previous level of 17 to 9·5. Evidence of the establishment of the parasite was also found in two other areas in Aragua, in the upper Tuy valley and in the Aragua valley, where the average percentage of injured joints was reduced from 16 to 11. Both *D. rosa* and *D. saccharalis* were attacked. On the estate in Yaracuy where *M. minense* was known to have become established [**42** 214], infestation by *Diatraea* had increased, owing to the accidental introduction of *D. b. busckella*, which was not parasitised by *M. minense*; parasitism of *D. saccharalis* reached 43 per cent.

In the Turbio valley, in Yaracuy and Lara, infestation by *Diatraea* is heavy but as insecticides are widely used against *Aeneolamia varia sontica* Fennah on sugar-cane there, *M. minense* was released only on estates free from this froghopper. Establishment was confirmed on one estate in 1953, where 47 per cent. of a sample of *D. saccharalis* was attacked, though no parasitism of *D. b. busckella* was observed. Although there had been no evidence of the establishment of *M. minense* from releases in the Tocuyo valley, Lara, by March 1952, further liberations were made and the parasite was found to be firmly established and giving good control in February 1953, an average of about 20 per cent. parasitism of the total *Diatraea* population being observed over an area of at least 3,600 acres. Damage by *Diatraea* in this area was formerly the most severe in Venezuela, *D. saccharalis*, *D. b. busckella*, *D. impersonatella* (Wlk.) and *Eodiatraea centrella* (Möschler) (*D. canella* Hmps.) all being present; the last species, which attacks primarily young ratoon plants, has never been found parasitised by *M. minense* in Venezuela [*cf.* **29** 538, etc.; **30** 221]. In one sample of 50 dead-hearts, the parasitism percentages were 50 for *D. saccharalis*, 25 for *D. b. busckella* and 9 for *D. impersonatella*. Parasitism was found to be good even when populations of *Diatraea* were low, and eventual control of the borers in this area is thought to be assured. A note is appended in which it is reported that an adult of *M. minense* was reared from a larva of *D. saccharalis* taken in December 1952 on sugar-cane in the Orinoco delta. Since the parasite is not indigenous in this area, it is thought to have spread from British Guiana, where it was released in 1933–34 [*cf.* **22** 388], though the place at which it was taken was 190 miles from the site of the nearest liberation point. It is concluded that spread was facilitated by the occurrence of *D. saccharalis* on water-grasses growing along the rivers.

Simmonds (F. J.). **Insect Pests of Sugar-cane in the French Antilles.**— *Trop. Agriculture* **30** no. 4–6 pp. 122–127, 3 refs. Trinidad, 1953.

Sugar-cane was observed during a recent visit to Guadeloupe and Martinique to be attacked on both islands by *Diatraea saccharalis* (F.) [*cf. R.A.E.*, A **17** 160], *Laphygma frugiperda* (S. & A.) [*cf.* **17** 458], *Metamasius hemipterus* (L.), *Saccharosydne saccharivora* (Westw.), *Sipha flava* (Forbes), *Saccharicoccus sacchari* (Ckll.) and *Schistocerca pallens* (Thnb.). *Eodiatraea centrella* (Möschler) (*D. canella* Hmps.) and *Blissus insularis* Barber were present on the cane in Martinique, and small numbers of larvae of *Diaprepes* sp. were found infesting the roots in Guadeloupe. Dry cane on both islands was attacked by termites. *Diatraea saccharalis* was the major pest. On both islands the eggs were parasitised by *Trichogramma minutum* Ril. and *Telenomus* (*Prophanurus*) *alecto* (Crwf.), and the larvae by *Agathis stigmatera* (Cress.), which was rare, and *Metagonistylum minense* Tns. *Lixophaga diatraeae* (Tns.) parasitised the larvae in Guadeloupe. *M. minense* is thought to have been introduced from St. Lucia [**27** 182]

into Martinique in 1934 and thence into Guadeloupe in 1938. *L. diatraeae* was introduced into Guadeloupe apparently in 1947–48. *Metagonistylum* reduced the infestation at first, but the recent introduction of high-yielding varieties of cane that are more susceptible to attack by *Diatraea* has resulted in increased damage and a reduction of at least 5 per cent. in the yield of sugar. It was confirmed in Guadeloupe that *Metagonistylum* of the Amazon strain is more abundant in areas of high rainfall and *Lixophaga* in drier ones, though each could survive under the reverse conditions. The desirability of introducing *Paratheresia claripalpis* (Wulp) into the islands to supplement the other parasites is discussed.

Tripp (H. A.). **Description and Habits of the Spruce Seedworm,** (*Laspeyresia youngana* (**Kft.**)) (**Lepidoptera: Olethreutidae**).—*Canad. Ent.* **86** no. 9 pp. 385–402, 17 figs., 12 refs. Ottawa, 1954.

Studies on the insects that attack the cones of white spruce (*Picea glauca*) in Canada were begun in 1948 in view of increased requirements of seed by nurseries, and an account is given in this paper of investigations in 1950–52 on one of the more important pests, *Cydia* (*Laspeyresia*) *youngana* (Kearfott), all stages of which are described. This moth also infests other species of *Picea*, and it occurs throughout eastern Canada and the north-eastern United States and also in the west of both countries. The larvae could not be reared in the laboratory, and the bionomics were studied mainly by the dissection of cones collected throughout the year in Ontario. These were numerous in 1950, but less plentiful in 1951 and 1952, when infestation was fairly high; cones of the previous year were also collected in southern Ontario and neighbouring parts of Quebec.

Adults emerged in the laboratory and were present in the field in May. The females were inactive, and there was a tendency for heavy infestations to develop on old cone-bearing trees, young trees being rarely attacked unless growing near old ones and nursery trees that were isolated from mature spruce being uninfested. The females rarely survived for more than five days, but one male survived for 11 and another for 12 days. In the laboratory, oviposition began on the day after emergence, and eggs were found in the field three days after adults were first seen. They were deposited singly between the scales of the cone, mostly in the apical half. In 1950, about 50 per cent. of the cones examined were infested and most contained only one egg, but over 90 per cent. were infested in 1951 and most contained 12 eggs, though as many as 31 were found in one cone. In the laboratory, the numbers of eggs laid per female averaged 60. Oviposition began in the field when the average weekly temperature was about 60°F., and the oviposition period and egg stage each lasted about ten days. The larvae passed through three instars in about 40 days and hibernated in the fourth. They mined in the scales and finally in the ovules in the first instar, continued to feed in the ovules in the second and entered the rachis in the third, tunnelling through it to the base, and boring holes into the ovules, on which they fed until early September. Winter was passed in the rachis, and pupation occurred in a silken tube spun in it in early May; the adult emerged after about 18 days through a hole made at the base in the previous September. The larvae are cannibalistic and usually only one completed its development in each cone, though two sometimes survived in a large cone. Some larvae remained in diapause for one, two or even more years, and the percentage that did so appeared to be correlated with the abundance of cones, since no larvae in diapause were observed in the spring of 1950, whereas about 29 per cent. were in diapause in the spring of 1951.

Bond (E. J.) & Monro (H. A. U.). **Rearing the Cadelle *Tenebroides mauritanicus* (L.) (Coleoptera: Ostomidae) as a Test Insect for insecticidal Research.**—*Canad. Ent.* **86** no. 9 pp. 402–408, 3 figs., 5 refs. Ottawa, 1954.

Tenebroides mauritanicus (L.) is troublesome though not of prime importance as a pest of stored products, and as it is of value as a test insect in fumigation work and reacts rather differently from other pests to some of the fumigants commonly used [*cf. R.A.E.*, A **40** 382], a technique was sought for breeding it in the laboratory. The main difficulty was the provision of conditions suitable for oviposition. Two media that were successfully used in Canada and a method of rearing all stages are described in this paper, which also contains a summary of the bionomics of the insect [*cf.* **12** 93] and descriptions of characters distinguishing the sexes in the adults and pupae. One of the media was prepared by firmly packing 150 gm. oatmeal into a quart jar with a false bottom of plastic screen and pouring into it 75 ml. water so that the centre was soaked and the outside remained dry; if the outer layers of oatmeal became wet, they shrank away from the jar, leaving a space in which the adults were liable to be trapped. The medium was then kept at 77°F. to allow a mould to develop in the moist oatmeal, where it formed a solid mass of mycelium. After two days, when sufficient mould had been produced, five pairs of adults were placed in each jar. Egg production diminished if the medium was not renewed every two weeks. The other medium was prepared by moistening 100 gm. oatmeal containing 5 per cent. brewer's yeast with 30 ml. water in which 2 gm. agar had been dissolved; 3 gm. of the mixture in a petri dish supported three pairs of adults, but needed replacing twice a week.

The eggs of *T. mauritanicus* are about 0·27 mm. in diameter and are laid in crevices. Special egg-laying blocks were therefore provided, consisting of two 1-inch squares of transparent plastic sheet, $\frac{3}{16}$ in. thick, held together by an elastic band and separated by two thicknesses of paper, each $\frac{3}{8}$ in. square, glued into the centre of one of them, so that they were held 0·3 mm. apart. The eggs could be readily seen and counted and were transferred daily to petri dishes, in which they were kept until they hatched, or directly to whole wheat flour, on which the larvae developed. At 77°F. and 70 per cent. relative humidity, the eggs hatched in 7–8 days.

In the mould medium, as many as 3,581 eggs were laid by one female, but the total and daily numbers produced varied greatly. The percentage hatch among eggs laid by nine females ranged from 57·8 to 76·9, but was sometimes much higher. The number of eggs produced declined towards the end of the oviposition period, but the number per cluster remained about the same throughout the life of each female. The larval stage lasted eight weeks, 84·9 per cent. of the larvae reached the last (fourth) instar, in which they are mostly used in fumigation tests, and 65·7 per cent. gave rise to adults. Food media other than whole wheat flour were less successful. Pieces of coarse building cork cut into $\frac{1}{2}$-inch cubes were placed on the surface of the wheat when the larvae were ready to pupate, and the larvae excavated their pupal cells in these. The combined prepupal and pupal stages lasted 10–20 days, but some individuals remained in the larval stage for several weeks after completing their cells in the cork.

Williams (J. B.). **Occurrence of Adults of the Carrot Rust Fly, *Psila rosae* (Fab.) (Diptera: Psilidae), on Corn Foliage at Bradford, Ontario.**—*Canad. Ent.* **86** no. 9 pp. 414–415, 11 refs. Ottawa, 1954.

Adults of *Psila rosae* (F.) are difficult to find in the field, but have been reported from a variety of situations [*cf. R.A.E.*, A **31** 24, 229; **35** 26].

though they rarely occur in them in appreciable numbers for many days. In 1952, large numbers of first-generation adults were observed on the foliage of a row of maize immediately to the north of several plots of carrots. They remained on the maize from 12th August until 15th September, with peak numbers on 5th September, and were most abundant about sunset and moderately numerous in the early morning. Few were found elsewhere. Five were seen on the carrot plants between 30th July and 27th August, but infestation of these by second-generation larvae was heavy, so that the females probably visited the carrots for oviposition a few at a time. It was not known whether the males ever entered the carrot fields.

STEHR (G.). **A Laboratory Method for rearing the Spruce Budworm, *Choristoneura fumiferana* (Clem.), (Lepidoptera: Tortricidae).**—*Canad. Ent.* **86** no. 9 pp. 423–428, 7 figs., 3 refs. Ottawa, 1954.

Choristoneura fumiferana (Clem.) is normally difficult to rear in the laboratory since it passes through only one generation a year, the larvae remain in diapause for about ten months, mortality is high, and its natural food (young shoots of *Abies* [*balsamea*] and spruce) is available for a relatively short period, but a method that enabled several generations to develop during the year and provided ready access to the cultures was devised in Canada. The active stages were maintained at a constant temperature of 21·5°C. [70·7°F.] and a relative humidity of 68–75 per cent., and no stage was handled directly. Mating and oviposition took place in glass jars, lined with wax paper and ventilated through wire screen in the lid, each containing one pair of adults and a twig of *A. balsamea* of the previous year. Oviposition usually began one day after pairing and continued for up to seven days, after which the few eggs laid were usually infertile. Hatching occurred in 6–8 days, and the egg clusters were removed daily, not less than 24 hours before it, and the needles or waxed paper bearing them glued to the lower part of a petri dish. This was subsequently sealed by means of a piece of semi-translucent parafilm with a double layer of gauze fastened to its lower surface, the film being pressed over the rim; the whole output of one female, or up to 12 average-sized clusters, could be accommodated in one dish. The petri dish, with the upper half replaced, was inserted into an envelope of dark paper with a number of small holes in the side nearest the gauze and inverted on a light-table so that reflected light illuminated the part of the film backed by the gauze. On hatching, the larvae were attracted to the diffuse light [*cf. R.A.E.*, A **38** 98], dropped on to the gauze and constructed their hibernacula in the meshes. They reached the second instar within two weeks of oviposition, and the parafilm bearing the larvae was transferred 2–4 weeks later to a temperature of 5 or 0°C. [41 or 32°F.] for hibernation. Some larvae completed their development after storage for 26 weeks at 5°C., but survival was higher after only 12–25 weeks or after storage at 0°C. When fresh food was not available, buds of *A. balsamea* collected in spring, deep-frozen for several hours at −70°C. [−94°F.], and stored at −5°C. [23°F.] until required, were provided, freshly thawed buds being dried and placed in the dishes when these were returned to the rearing temperature. Peak emergence of larvae from the hibernacula rarely occurred until three days after removal from cold storage, but the rate was influenced by temperature, humidity and the duration of hibernation. The larvae were attracted to the buds by means of the diffuse-light reaction, and the dishes kept darkened to facilitate establishment; as the dishes were not ventilated, moisture tended to appear in them and was removed by blowing. It was not necessary to renew the food of the second- and third-instar larvae for

6–8 days; by the time the sixth instar is reached, it may be desirable to reduce the number of larvae per dish to 4–6. The larvae pupated 3–4 weeks after emerging from the hibernacula, and the pupae were placed on filter paper or paper towelling in screw-top vials, in which adult emergence occurred in about seven days. The adults remained in good condition in the vials for 8–10 days at 5°C., and some paired successfully after storage for more than three weeks. An average of 60–65 per cent. of the original parents produced normal numbers of fertile eggs; 25–30 per cent. of the latter gave rise to second-instar larvae that hibernated and became established on the buds, and 60–80 per cent. of these completed their development. There was a six-fold increase per generation, and four consecutive generations were reared without apparent detrimental effects.

JOHNSON (P. C.). **A Hibernation Record of *Ips plastographus* Leconte (Coleoptera: Scolytidae).**—*Canad. Ent.* **86** no. 9 pp. 431–432, 1 ref. Ottawa, 1954.

Adults of *Ips plastographus* (Lec.) [*cf. R.A.E.*, A **13** 125; **15** 434] were found on 22nd September 1950 overwintering in the sapwood of wind-felled lodgepole pine [*Pinus contorta*] in a forest in Montana. They appeared to be the progeny of beetles that had earlier in the year attacked trees uprooted by the wind in November 1949, and are thought to have entered the trees in which they were overwintering early in September. There was no evidence of breeding in these trees, and irregular winding galleries between the surface of the inner bark and the sapwood appeared to be adult feeding tunnels.

HAWBOLDT (L. S.) & CUMING (F. G.). **Cankerworms and European Winter Moth in Nova Scotia.**—*Bi-m. Progr. Rep. For. Insect Invest. Dep. Agric. Can.* **6** no. 1 pp. 1–2, 1 ref. Ottawa, 1950.

SMITH (C. C.). **Notes on the European Winter Moth in Nova Scotia.**—*T. c.* no. 2 p. 1.

MORRIS (R. F.) & REEKS (W. A.). **A larval Population Technique for the Winter Moth (*Operophtera brumata* (Linn.) (Lepidoptera: Geometridae)).**—*Canad. Ent.* **86** no. 10 pp. 433–438, 5 refs. Ottawa, 1954.

Outbreaks of Lepidopterous larvae that had occurred almost continuously since about 1930 on the leaves of deciduous trees in southern Nova Scotia are stated in the first paper to have been attributed at first to the fall cankerworm, *Alsophila pometaria* (Harris), and the spring cankerworm, *Paleacrita vernata* Peck. The identity of the second species was uncertain, however, since there appeared to be no emergence of adults in spring. Collections were accordingly made by means of adhesive bands in the autumn of 1949, and the adults obtained were found to comprise *A. pometaria* and *Operophtera brumata* (L.). No positive record has been found of *P. vernata* in Nova Scotia, and previous records of outbreaks of the spring cankerworm there probably refer to *O. brumata*.

In the second paper, the outbreak of *O. brumata* in Nova Scotia is stated to constitute the first record of this Geometrid in North America. Defoliation was severe on apple and hawthorn [*Crataegus*], and less so on chokecherry [*Prunus virginiana*], basswood [*Tilia americana*], oak, elm, white ash [*Fraxinus americana*], hop-hornbeam [*Ostrya virginiana*], red maple [*Acer rubrum*], and white and yellow birch [*Betula papyrifera* and

B. lutea]. Field-collected larvae reared in screen cages in the open entered the soil between 14th and 20th June and constructed silken cocoons at a depth of ½–1 inch, in which they had pupated five days later. Adults emerged between 15th October and 14th November, when air temperatures were as low as 20°F. and snow fell to depths of 0·7 and 2·7 ins. but subsequently melted. Emergence ceased when about 95 per cent. of the adults had appeared and soil temperatures at a depth of one inch fell to 36°F. Emergence of the males began before that of the females, and of 494 adults obtained, 277 were females. The eggs of *O. brumata* were laid in groups of 6–15 and those of *A. pometaria* in masses of about 150; other differences noted between the two species were that the last-instar larvae of *O. brumata* often rolled the leaves of their food-plants and that the prepupal stage of *A. pometaria* lasted about a month.

In the third paper, the authors describe investigations to develop a sampling technique for studying larval populations of *O. brumata*, carried out in 1952–53 on young dominant and co-dominant trees in stands of red oak (*Quercus borealis*), which appears to be the food-plant preferred next to apple in Nova Scotia. Infestation on the trees selected had previously been only light or moderate in intensity, but the percentage defoliation in early June in 1952 and 1953, when the samples were taken and most larvae were in the fourth instar, averaged 45 and 77, respectively; by late June, when the larvae had ceased feeding, it had increased to 60 and 85, respectively. Populations were estimated as the number of larvae per leaf and per leaf cluster (comprising all the leaves on one new shoot) on branch terminals collected from different positions in the crown. Larvae of both *O. brumata* and *A. pometaria* were present, but in both years the former comprised about 92 per cent. of the total.

Populations were found to differ significantly from tree to tree, whether assessed per leaf or per leaf cluster. The number of leaves per cluster showed a similar significant difference, and populations at different levels in the crown also differed significantly in 1953, owing to the greater number of leaves per cluster in the upper levels. Under the conditions of the investigation, samples comprising 12 leaf clusters per tree appeared to be the most suitable, the standard errors in populations assessed on samples of this size from 8 and 32 trees per plot being 10 and 5 per cent., respectively. The leaf is statistically slightly superior to the leaf cluster as a sample unit, but not sufficiently so to compensate for the extra labour involved in its use. The number of leaves per cluster is probably influenced by the vigour of the tree and is therefore likely to vary from year to year and to be reduced by repeated defoliation; a reduction in the number of leaves per shoot would result in an apparent increase in the population per leaf, but not per leaf cluster.

McGugan (B. M.). **Needle-mining Habits and larval Instars of the Spruce Budworm.**—*Canad. Ent.* **86** no. 10 pp. 439–454, 4 figs., 24 refs. Ottawa, 1954.

Studies on the development of *Choristoneura fumiferana* (Clem.), mostly on balsam fir [*Abies balsamea*] but also on spruce, were begun in north-western Ontario in 1946, when a large-scale outbreak was in progress. The results showed that the eggs were laid singly or in rows of up to almost 60 on either side of the needles, beginning near the tip. The average numbers of eggs deposited per female in 1946, 1947 and 1948 were 111, 119 and 99, respectively, and the number of clusters varied from 1 to 27 and averaged about six. Most females oviposited within 24 hours of pairing and usually

continued to do so for 4–6 days. The egg stage varied from an average of less than eight to over 12 days, according to season. The duration of the larval instars was variable, but the fifth was the shortest and the sixth the longest. Males developed more rapidly than females, and both the larval and pupal stages were shorter on white spruce [*Picea glauca*] than on balsam fir, the pupal stage lasting for an average of 8–9 days. The survival period of 84 adults that had paired and 199 that had not varied from two to 20 days; females generally survived longer than males and adults that had not paired longer than those that had.

A detailed account is given of observations on the needle-mining activities of the overwintered larvae in a stand of immature spruce and balsam fir that was heavily infested until 1949. Activity on balsam fir was found to be basically similar each year, irrespective of widely differing weather conditions. Most of the larvae mined only one needle before entering the vegetative buds, but a few mined several and a few none. In 1946–48, 87–98 per cent. of the mines were in needles of the previous year; second- and third-instar larvae were found in both buds and mines. Spruce needles quickly dry out when mined, and, probably in consequence, single larvae were not uncommonly associated with groups of 2–6 mined needles. Buds of black spruce [*P. mariana*] open later than those of either balsam fir or white spruce, and the larvae mined in the needles of this food-plant for a considerably longer period.

The number of larval instars was studied in larvae reared in the laboratory and by the measurement of the head capsules of examples collected from balsam fir throughout the development period. There were found to be not more than six. Attempts to separate the instars on a single character were unsuccessful, but a key for their separation based on several characters is included. The width of the head capsule was the best single criterion but was greater in females than in males and smaller in larvae parasitised by *Apanteles fumiferanae* Vier. than in unparasitised ones.

MacGillivray (M. E.). **Note on** *Myzus ascalonicus* **Doncaster (Homoptera: Aphidae), an Aphid new to North America.**—*Canad. Ent.* **86** no. 10 p. 454, 2 refs. Ottawa, 1954.

The author records the discovery of *Myzus ascalonicus* Doncaster on chrysanthemum cuttings and carrot in Canada [*cf. R.A.E.*, A **43** 443] and briefly reviews the habits of that Aphid in England [*cf.* **35** 206].

Cumming (M. E. P.). **Notes on the Spruce Needle Miner,** *Taniva albolineana* **Kft. (Olethreutidae: Lepidoptera).**—*Canad. Ent.* **86** no. 10 pp. 457–460, 2 figs., 5 refs. Ottawa, 1954.

An account is given of the bionomics of *Taniva albolineana* (Kearfott), which mines the needles of spruces of various species in Canada and the United States, based mainly on observations in 1944 on heavily infested Chinese spruce (*Picea asperata*) at a forest nursery station in Saskatchewan. Ornamental spruces are more often infested than forest trees, and young trees growing under adverse conditions are especially liable to injury. The trees concerned were 15 years of age but only 5 ft. high, since the buds of the current year's growth had been killed by all but the mildest winters.

The females lay their eggs on the needles of the thickest growth, in rows of 3–10 arranged along one side. Hatching begins as early as June and extends over a considerable period. The larvae pass through six instars and feed in the old needles, which they hollow out from the base. There

is usually only one larva per needle, though two young ones are occasionally present. Dead needles and frass are webbed together by several larvae, apparently all from the same row of eggs, to form a communal shelter; the numbers of larvae in 124 such shelters ranged up to 11 and averaged three. The shelters are usually situated near the bases of the large branches and, on small trees, on the lower crown next to the trunk, and may include twigs from two or three branches, though usually only one twig is involved. The larvae feed until October and some become full-fed by that time. The others feed again in spring, until mid-May or early June. They rarely leave the needles during summer and autumn, and some may overwinter in them, though most do so in loosely constructed cocoons of silk with adhering frass. Some empty shelters were found in autumn, indicating that the larvae may then move to another site. Pupation takes place in the shelter within cocoons of frass and silk; occasionally the cocoon is made within a case composed of spruce needles. Larvae and pupae were both present from 9th May, when early pupae comprised about 50 per cent. of the population. Adult emergence began on 20th May, the pupal period probably lasting about two weeks. Emergence in field cages continued from 27th May to 26th June; of the 36 adults concerned, 20 emerged in the first week. In the insectary, 13 males survived for an average of 7·4 days and 19 females for 9·6. Several parasites were reared from *T. albolineana*, of which the commonest was an unidentified species of *Ascogaster*; it was obtained from collections in various places in Alberta and Saskatchewan, and parasitism by it was at times quite high. The other parasites observed were *Itoplectis quadricingulatus* (Prov.), *Agathis bicolor* (Prov.), two unidentified species of *Apanteles* and one each of *Bracon* and *Angitia* (*Horogenes*).

Reeks (W. A.). **An Outbreak of the Larch Sawfly (*Pristiphora erichsonii* (Htg.)) in the Maritime Provinces (Hymenoptera; Tenthredinidae) and the Role of Parasites in its Control.**—*Canad. Ent.* **86** no. 10 pp. 471–480, 1 fig., 1 map, 7 refs. Ottawa, 1954.

An outbreak of *Pristiphora erichsonii* (Htg.) on larch occurred in eastern Canada in 1933–42. New Brunswick was affected throughout that period, Nova Scotia in 1935–42 and Prince Edward Island in 1937–39. Observations in the course of it showed that severe infestation rarely persisted in a stand for more than four years and never for more than five; pure stands of larch up to 20 years of age were seldom attacked. Tree mortality was highest in southern coastal areas of New Brunswick and Prince Edward Island, where it ranged up to 5 per cent. Twig mortality varied from 10 to 50 per cent. and was severe where defoliation exceeded 70 per cent. for 3–4 successive years.

Larvae and cocoons were collected at various places throughout the infested region and reared, mostly out of doors, to provide data on the bionomics of the sawfly and on its parasites. There was usually only one generation a year, but second-generation adults emerged from up to 2 per cent. of the cocoons in some years. In 1 per cent. of the cocoons, diapause continued for two years. Of some 3,000 adults reared, 99·3 per cent. were females. The numbers of eggs laid per female by small numbers under observation were 60–206 in 1937, 24–100 in 1941 and 20–90 in 1942, and the number of oocytes left in the ovaries when oviposition was complete averaged seven in each year. The females originated from a stand that had been severely defoliated for several years, and the reduction in fecundity may have been due to partial starvation. Winter was passed in the eonymphal and

pronymphal stages in the cocoon, 57–100 per cent. of the prepupae overwintering as conymphs and the proportion to do so being highest when the ground temperature in autumn was low and parasitism by *Mesoleius aulicus* (Grav.) (*tenthredinis* Morl.) heavy.

The chief parasites reared from the cocoons were *Ptychomyia selecta* (Mg.) (*Bessa harveyi* (Tns.)) and *M. aulicus*; small numbers of others, including *Dahlbominus fuscipennis* (Zett.), *Eclytus ornatus* Hlmgr., *Aptesis indistincta* (Prov.), and an unidentified species of *Eucelos*, were also obtained, but afforded less than 1 per cent. parasitism. *P. selecta* was the most effective species until 1937. Its importance varied considerably from stand to stand, but the average percentage parasitism by it in the various years ranged from 3·6 to nearly 34, and up to 50 per cent. of the cocoons were occasionally attacked; as it sometimes leaves the host cocoons to pupate, it may have been more abundant than the data indicated. Usually only one individual completed its development per host. In central New Brunswick, this Tachinid usually had one generation and a partial second per year; the second-generation adults were only partly synchronised with the host larvae, but other insects are also attacked. It is concluded that the parasite was of importance in reducing the outbreak and that it is more effective against *P. erichsonii* than it is against *Gilpinia* (*Diprion*) *hercyniae* (Htg.) [*cf. R.A.E.*, A **37** 284], though the same reducing factors probably operated.

M. aulicus was introduced into Quebec in 1910–11, but there is no evidence of subsequent spread to the Maritime Provinces. In 1927, 24 adults of this Ichneumonid were liberated near Fredericton, New Brunswick, but no recoveries were made. After further liberations of small colonies in 1935–38 and in Nova Scotia in 1937–42, however, the parasite was recovered at distances of up to 16 miles after one year and 22–40 miles after two. There was no evidence of encapsulation of the eggs within the host larvae [*cf.* **43** 133]. From 1938, it became the chief control agent, the percentage parasitism averaging 18·1–49·9 and ranging up to 71·4 in one year.

Collections of old cocoons and of cocoons of the current season were made in the autumn of 1941. Of the old ones, 25 per cent. had been destroyed by insect predators, probably Elaterids, about the same proportion by small mammals, and less than 9 per cent. by parasites; some 48 per cent. of the cocoons of the current year were destroyed by parasites. The occupants of about 22 per cent. of some 8,000 cocoons dissected periodically in the course of the work died during the autumn or spring, and about 10 per cent. of nearly 2,000 old cocoons were empty or contained dead adults; the causes of this mortality are unknown, but may have included exposure to excessive water during the construction of the cocoon or immediately after the resumption of development in spring [*cf.* **39** 435].

During 1940–47, 11 colonies of *M. aulicus* were liberated in Newfoundland, where an outbreak of *Pristiphora* had been in progress since 1942 or earlier, but few parasites were subsequently recovered, and infestation of larch was severe in 1953.

Fukuto (T. R.), Metcalf (R. L.), March (R. B.) & Maxon (M. G.). **Chemical Behavior of Systox Isomers in biological Systems.**—*J. econ. Ent.* **48** no. 4 pp. 347–354, 4 figs., 12 refs. Menasha, Wis., 1955.

In this second paper of a series [*cf. R.A.E.*, A **43** 421], an account is given of investigations on the oxidation products of O,O-diethyl O-ethyl-2-mercaptoethyl phosphorothionate [demeton-O] and O,O-diethyl S-ethyl-2-mercaptoethyl phosphorothiolate [demeton-S], the two isomers present in Systox, carried out in view of the possibility that they include the toxic

metabolites to which the two isomers are converted [*cf.* **43** 422]. Demeton-O was oxidised to form O,O-diethyl O-ethyl-2-sulphinylethyl phosphorothionate (the thionophosphate sulphoxide), O,O-diethyl O-ethyl-2-sulphonylethyl phosphorothionate (the thionophosphate sulphone), O,O-diethyl O-ethyl-2-mercaptoethyl phosphate, O,O-diethyl O-ethyl-2-sulphinylethyl phosphate (the phosphate sulphoxide) and O,O-diethyl O-ethyl-2-sulphonylethyl phosphate (the phosphate sulphone) and demeton-S to form O,O-diethyl S-ethyl-2-sulphinylethyl phosphorothiolate (the thiolphosphate sulphoxide) and O,O-diethyl S-ethyl-2-sulphonylethyl phosphorothiolate (the thiolphosphate sulphone), and these were compared with the metabolised products recovered from cotton plants after application of the two isomers to the base.

Comparison of the results obtained from paper chromatography of the synthetic products and metabolites labelled with ^{32}P with those from tests of the inhibition of fly-brain cholinesterase by the various products, of the contact toxicity of the oxidation products to *Metatetranychus citri* (McG.), *Heliothrips haemorrhoïdalis* (Bch.) and *Musca domestica* L., of their toxicity on injection into white mice and their toxicity to *H. haemorrhoidalis*, *Tetranychus telarius* (L.) and *Aphis gossypii* Glov. on leaves from treated cotton plants indicated that demeton-O is metabolised to the thionophosphate sulphoxide, which is then converted to the thionophosphate sulphone, the phosphate sulphoxide or both, and that demeton-S is metabolised to the thiolphosphate sulphoxide and then possibly to the corresponding sulphone.

Hydrolysis of the oxidation products produced either O,O-diethyl phosphoric acid or O,O-diethyl thiophosphoric acid, neither of which is toxic, and it was shown that the phosphate product, which had poor contact and systemic toxicity but high anticholinesterase activity *in vitro*, hydrolysed rapidly, whereas the thiolphosphate sulphoxide and sulphone and the thionophosphate sulphoxide, which had prolonged systemic activity, were relatively stable to hydrolysis.

March (R. B.), Metcalf (R. L.), Fukuto (T. R.) & Maxon (M. G.). **Metabolism of Systox in the White Mouse and American Cockroach.** —*J. econ. Ent.* **48** no. 4 pp. 355–363, 3 figs., 24 refs. Menasha, Wis., 1955.

The following is based on the authors' summary of this third paper in a series [*cf.* preceding abstract, etc.]. Investigations on the fate of the two isomers present in Systox, O,O-diethyl O-ethyl-2-mercaptoethyl phosphorothionate [demeton-O] and O,O-diethyl S-ethyl-2-mercaptoethyl phosphorothiolate [demeton-S] in white mice and cockroaches (*Periplaneta americana* (L.)) showed that both compounds were rapidly metabolised, degraded and eliminated. The principal route of elimination in the mouse was the urine, 50–70 per cent. of an orally administered dose being eliminated within 24 hours. Of the compounds eliminated, 90 per cent. consisted of water-partitioning ionic degradation products and the remainder principally of chloroform-partitioning toxic metabolites, only traces being eliminated as the unchanged isomers. The liver was the principal organ of metabolism and degradation.

The process was similar but somewhat slower in cockroaches treated topically or by injection. The foregut showed a marked selective absorption of the isomers, and the gut was the principal avenue of elimination, although other tissues, including nerve and muscle, played a more active part than in mice.

Conversion to toxic metabolites appeared to take place by oxidation of the mercapto sulphur to the respective sulphoxides and sulphones, but a

secondary process in the case of demeton-O involved oxidation of the thiono sulphur to produce the corresponding phosphate and its sulphoxide and sulphone [*cf.* preceding abstract]. Both isomers and their toxic metabolites were degraded by hydrolysis, forming O,O-diethyl phosphoric acid or O,O-diethyl thiophosphoric acid and the respective alcohols.

Metcalf (R. L.), March (R. B.), Fukuto (T. R.) & Maxon (M. G.). **The Nature and Significance of Systox Residues in Plant Materials.** —*J. econ. Ent.* **48** no. 4 pp. 364–369, 4 graphs, 8 refs. Menasha, Wis., 1955.

In this fourth paper of a series [*cf.* preceding abstract, etc.], the significance of spray residues of the two Systox isomers, O,O-diethyl O-ethyl-2-mercaptoethyl phosphoronothionate [demeton-O] and O,O-diethyl S-ethyl-2-mercaptoethyl phosphorothiolate [demeton-S], in edible plant materials is assessed. The tests were carried out largely by the use of isomers labelled with ^{32}P, and the following is largely based on the authors' summary.

Paper chromatography of extracts of the residues in orange, apple and walnut fruits at intervals after treatment at about 30 times the concentration normally used in insect control showed that the two isomers were metabolised in the same way as in foliage [*cf. R.A.E.*, A **43** 422]. Within 1–2 weeks of the application of either isomer, almost no trace of the initial material could be found in the fruit tissues, but oxidation products were present. The major constituents of these appeared to be the thiol- and thionophosphate sulphoxides, the phosphate sulphoxide and possibly the thiol- and thionophosphate sulphones. The action of air and sunlight on surface residues of demeton-O and demeton-S was also rapid, apparently promoting their oxidation in the same sequence as occurs in plant tissues and *in vitro*. The oxidation products formed in the plant tissues were subsequently hydrolysed to non-toxic diethyl phosphoric acids and alcohols [*cf.* preceding abstract]. The metabolites of demeton-S persist in leaf and fruit tissues for about twice as long as those of demeton-O, the half-lives in cotton leaves and orange pulp being 18 and 30 days, respectively, for demeton-S, and 8 and 20 days for demeton-O.

From these results and those recorded in the earlier parts of the series, it is concluded that the thiolphosphate sulphoxide and the thiolphosphate sulphone are probably the main toxic plant metabolites resulting from the application of Systox, especially since demeton-S and its metabolites have been shown to accumulate in treated plants 5–10 times as quickly as the products of demeton-O applied at the same rate. The thiolphosphate sulphoxide and sulphone are about five and ten times as active, respectively, as technical Systox in inhibiting cholinesterase, so that residues in plants treated with radioactive Systox appear to be 5–10 times as large when measured by anticholinesterase assay as when measured by radioassay. The presence of the toxic metabolites in edible plant products is unlikely to increase the danger due to Systox residues, as metabolism of the isomers in mammals and plants is similar [*cf.* preceding abstract], so that animals are exposed to essentially the same toxic processes whether the isomers are ingested in the original or in metabolised form. The hydrolysis of the toxic metabolites in plant materials to non-toxic derivatives is a further safeguard against their retention or accumulation over a long period. Tests with radioactive Systox showed that the average residues 2–4 weeks after the application of standard commercial sprays were substantially below 0·1 part per million and generally in the range of 0·01–0·03 p.p.m. in orange juice, total apple peel and pulp, walnut meats, pear and potato, and such small amounts would not be detected by other methods of analysis.

Eaks (I. L.) & Sinclair (W. B.). **Respiratory Response of Avocado Fruits to Fumigation effective against the Eggs and Larvae of Fruit Flies.** —*J. econ. Ent.* **48** no. 4 pp. 369–372, 5 graphs, 5 refs. Menasha, Wis., 1955.

The following is largely based on the authors' summary. An account is given of investigations on the respiratory response of avocado fruits to fumigation treatments that are effective against the immature stages of fruit-flies in them. The fruits were fumigated with 1, 2 or 3 lb. ethylene dibromide, 1 or 3 lb. ethylene chlorobromide or 2 or 4 lb. methyl bromide per 1,000 cu. ft. for two hours or with 1·5 lb. ethylene dibromide per 1,000 cu. ft. for four hours at a temperature of 70°F. and 80 per cent. or more relative humidity, and records of respiration were made twice daily. The results showed that fumigation resulted in a striking stimulation in the rate of fruit respiration, the higher the rate of carbon-dioxide production, the more rapid in general being the rate of fruit deterioration. The degree of stimulation was related to the dosage of fumigant, except for ethylene dibromide. The results indicate that the initial rate of respiration of avocado fruits and the change in rate during storage provide a rapidly obtained objective index to the effect of fumigation on the subsequent response of the fruits during storage.

Gunther (F. A.), Jeppson (L. R.) & Wacker (G. B.). **Persistence of Chlorobenzilate Residues in mature Lemon Fruits.**—*J. econ. Ent.* **48** no. 4 pp. 372–374, 2 graphs, 5 refs. Menasha, Wis., 1955.

In the experiments described, lemon trees in California were sprayed on 31st March 1954 with 1 or 3 lb. 25 per cent. wettable Chlorobenzilate [ethyl 4,4′-dichlorobenzilate] per 100 U.S. gals. at the rate of about 1,000 U.S. gals. per acre and sample fruits were collected for the chemical or biological assay of residues 2–141 days later. It is estimated from the chemical analyses of the peel of the washed fruits that the initial deposits of Chlorobenzilate were about 20 and 40 parts per million for the two doses, that penetration into the peel was initially rapid and continued for at least 28 days, and that the acaricide had a long half-life (60–80 days) on and in the peel. Analysis of the pulp of the sprayed fruits showed residues of 0·1 and 0·2 p.p.m. for the two doses both 14 and 28 days after treatment and none later, indicating that Chlorobenzilate did not penetrate to the juice or pulp in appreciable amounts. For bioassay, the sprayed lemons were infested with batches of *Metatetranychus citri* (McG.) and left for 96 hours at a temperature of 70°F. and 50 per cent. relative humidity. Examination of the mortality records showed that the higher dosage was as effective after 120 days as was the lower one initially, mortality being about 70 per cent. and the effective deposit about 10 p.p.m. Mortality had fallen below 60 per cent. and the effective deposit to 7·5 p.p.m. 130 and 38 days after treatment with the higher and lower doses, respectively. It was evident that Chlorobenzilate was not highly toxic to the mite at economic rates of application.

Jeppson (L. R.), Jesser (M. J.) & Complin (J. O.). **Control of Mites on *Citrus* with Chlorobenzilate.**—*J. econ. Ent.* **48** no. 4 pp. 375–377, 5 refs. Menasha, Wis., 1955.

As Chlorobenzilate [ethyl 4,4′-dichlorobenzilate] gave promising control of *Aceria sheldoni* (Ewing) and *Brevipalpus lewisi* McG. in preliminary field

tests in California, more detailed experiments were carried out in *Citrus* orchards against these two mites, *Metatetranychus citri* (McG.), *Phyllocoptruta oleivora* (Ashm.) and *Eotetranychus yumensis* (McG.), sprays being applied at 300 U.S. gals. per acre and dusts at 100 lb. per acre.

Against *A. sheldoni*, Chlorobenzilate at 4 or 8 oz. per 100 U.S. gals. resulted in 1·5–2–19·5 per cent. infested buds and was equally effective in wettable-powder and emulsion sprays and more so than standard 1·75 per cent. light-medium petroleum oil. In further tests with the wettable powder, 2 oz. actual toxicant per 100 U.S. gals. was about as effective as 4 oz. in four trials and as 8 oz. in two of them, and increasing the concentration to 16 oz. did not improve control. The addition of polyglycol (Thiosolve 42-1A) to the wettable powder or of petroleum oil or kerosene to the emulsion concentrate, to improve wetting and penetration, was of no advantage.

Chlorobenzilate was less effective than Ovotran [p-chlorophenyl p-chlorobenzenesulphonate] or the standard oil spray against *M. citri*, for which it apparently has little toxicity [*cf.* preceding abstract], when the two materials were used at equal rates of active ingredient in conventional sprays or spray-blower applications, and, when applied as a 4 per cent. dust, it was much less effective against *P. oleivora* than sulphur dust, but it was as effective as sulphur in dust or spray when applied at 4 lb. per acre in a wettable-powder spray with a spray blower.

In preliminary tests, 4 and 8 oz. Chlorobenzilate per 100 U.S. gals., applied in April, approached 2·4 and 4·8 oz. Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite] and 4 and 8 oz. Ovotran in effectiveness against *E. yumensis*. In a wettable-powder or emulsion spray. 8 oz. Chlorobenzilate per 100 U.S. gals., applied on 24th July 1952, gave excellent control of *B. lewisi* and was more effective than 8 oz. DMC [1,1-bis(p-chlorophenyl)ethanol] or wettable Ovotran, 9·6 oz. wettable Sulphenone [p-chlorophenyl phenyl sulphone], 16 oz. wettable sulphur or 4·8 oz. wettable Aramite per 100 U.S. gals.; at 2–2·5 lb. per acre, it was more effective than 6·5 lb. Sulphenone or 2 lb. DMC when applied with a spray-blower on 22nd August 1952, but less so than 15–30 lb. wettable sulphur per acre when applied with a boom sprayer on 5th May 1953.

Evans (W. G.) & Gyrisco (G. G.). **Granulated Insecticides for Control of the European Chafer in Meadows.**—*J. econ. Ent.* **48** no. 4 pp. 384–386. 5 refs. Menasha, Wis., 1955.

Further details are given of experiments already noticed from a preliminary account [*R.A.E.*, A **42** 212] in which insecticides in granular form were tested for the control of larvae of *Amphimallon majalis* (Razoum.) in meadow land in New York. It was found that aldrin, dieldrin or heptachlor at 1 or 2 lb. actual toxicant per acre and chlordane at 10 lb. per acre, applied on 6th August 1953 [*cf. loc. cit.*], gave excellent control of two successive generations of *A. majalis*, as shown by counts of the larvae in soil samples in the autumns of 1953 and 1954, and resulted in hay yields in 1954 that were 9–12 times as great as those obtained from untreated plots. Toxaphene, which was much less effective, resulted in 3–6 times as much hay as no treatment. Analysis of aldrin and dieldrin residues showed only 0·1–0·46 part per million on the foliage five days after treatment, so that there would be little danger to animals feeding on the hay. In tests with dieldrin, cyclone and wheelbarrow seeders and a hand-operated fertiliser spreader were very effective means of applying the granules.

Brunson (M. H.). **Effect on the Oriental Fruit Moth of Parathion and EPN applied to control the Plum Curculio on Peach.**—*J. econ. Ent.* **48** no. 4 pp. 390–392, 2 refs. Menasha, Wis., 1955.

In further investigations in 1952–53 of the effect on *Cydia* (*Grapholitha*) *molesta* (Busck) of sprays of parathion and EPN [ethyl p-nitrophenyl thionobenzenephosphonate] applied for the control of *Conotrachelus nenuphar* (Hbst.) on peach in New Jersey [*cf. R.A.E.*, A **41** 208], wettable powders containing 15 and 25 per cent. active ingredient, respectively, were applied at 1·5 lb. per 100 U.S. gals. at shuck split and again about 10 and 20 days later; sulphur was included in all applications. Bait-trap catches in the two years showed 65 and 25 per cent. fewer moths, respectively, before the first application on 5th–8th May in the experimental orchards than in the controls (sprayed with lead arsenate), 88 and 75 per cent. fewer between that date and 15th June, and 89 and 95 per cent. fewer after 15th June, and counts of infested twigs showed 98 per cent. fewer than in the controls between mid-May and 20th June and 94–97 per cent. fewer after that date. Examination for damaged fruits on 18th August 1952 and 17th August 1953 showed 86 and 89 per cent. fewer, respectively, on trees treated with the organic sprays than on those receiving lead arsenate, indicating that the population of *C. molesta* had remained low throughout the first half of August and that few moths had migrated into the experimental orchards during the period of the third generation.

Observations during all four years showed that early-season sprays against *Conotrachelus* would not also control the moth without pre-harvest sprays unless they were applied thoroughly and there was no near source of reinfestation; if these conditions were not fulfilled, at least one more application about three weeks before harvest would be necessary on varieties that ripen in late August.

Hambleton (E. J.) & Fracker (S. B.). **Cooperative Control of the Desert Locust and other major Pests in the Middle East and South Asia.**—*J. econ. Ent.* **48** no. 4 pp. 392–395, 1 fig. Menasha, Wis., 1955.

The authors describe the development and methods of the Regional Locust Control Programme, which was conducted under the authority of various governmental organisations of the United States in 1951–54 for the control of *Schistocerca gregaria* (Forsk.) in parts of Africa and Asia, in cooperation with international agencies and local governments. Technical advisers, apparatus and materials were provided, training programmes were assisted, and work was carried out in nine countries. In tests with new insecticides, aldrin applied at 2–3 oz. per acre as a 60 per cent. solution diluted in kerosene or water, or as a 40 per cent. emulsion concentrate similarly diluted, gave promising results in Pakistan, Iraq and elsewhere [*cf. R.A.E.*, A **44** 217] and proved more economical than BHC, and dieldrin applied at 2 oz. per acre to egg beds up to 14 days before hatching gave almost complete control of the hoppers in East Africa. The programme was subsequently renamed the Regional Insect Control Programme and its scope extended to include other insect pests of crops.

Berry (N. O.). **Mexican Fruit Fly and Citrus Blackfly Control in Mexico.**—*J. econ. Ent.* **48** no. 4 pp. 414–416. Menasha, Wis., 1955.

Campaigns are being conducted in Mexico by United States research authorities in cooperation with local agencies against two pests of *Citrus*, *Aleurocanthus woglumi* Ashby and *Anastrepha ludens* Lw. That against *Aleurocanthus* was begun in 1950 in view of the spread of the Aleurodid to

the north and the danger of its becoming established in Texas. Surveys are carried out each year in the north of Mexico and incipient infestations destroyed by spraying [*cf. R.A.E.*, A **42** 270, etc.]. The pest was repeatedly found close to the border, but control was apparently maintained. Spread is effected by flight, the inclusion of infested foliage in consignments of fruit, the movement of nursery stock, and accidental transport of adults in vehicles, which is a likely source of spread into the United States.

Anastrepha ludens, which infests various fruits, is already established in north-eastern Mexico and migrates to Texas each autumn and winter [*cf.* **26** 325], but quarantine measures have prevented its spread from Texas to other parts of the United States. There is a danger that it may become established in north-western Mexico, however, and spread from there into California and Arizona, and the campaign is designed to prevent this. It has already been trapped on both sides of the border in California and Lower California. All trees in the area bearing host fruits are treated every 21 days with a bait-spray of brown sugar, tartar emetic and water, fruits are closely examined and grove sanitation is rigidly enforced, and it is believed that the fruit-fly can be eradicated because there is no wild host fruit in the area, as there is in the east [*cf.* **30** 274]. The only remaining method of introduction is by way of infested fruits, and arrangements have been made whereby mangoes, for which there is a ready market in the area, are fumigated with ethylene dibromide before being brought into it.

Wilson (J. W.) & Thames (W. H.). **The Effect of Particle Size of the active Ingredient in DDT Dust on Corn Earworm Control.**—*J. econ. Ent.* **48** no. 4 pp. 416–418, 5 refs. Menasha, Wis., 1955.

DDT has not proved entirely satisfactory for the control of *Heliothis zea* (Boddie) (*armigera*, auct.) on sweet maize in parts of the United States in which the crop is grown principally for the fresh market and the larvae are numerous towards the end of the growing season. Since the mean surface particle diameter of the materials used as diluents in insecticide dusts is usually 10 μ or less and that of the DDT used in commercial formulations 20 μ or more, the effect was investigated in central and southern Florida in 1953–54 of 5 per cent. dusts in which the DDT was ground to three smaller particle sizes. These were about 11·5, 9·8 and 4·1 μ mean surface diameter, and the diluted dust averaged 1·8 μ in each case. Sweet maize sown to mature in May and sprayed four times before silking with 1 U.S. quart 25 per cent. DDT emulsion concentrate in 100 U.S. gals. water per acre for the control of larvae of *Laphygma frugiperda* (S. & A.) and *H. zea* was dusted at two-day intervals six times beginning on the day after the first silks had appeared or five times beginning when about 10 per cent. of the ears were in silk, but records of the percentages of uninfested ears at harvest on plants treated with a commercial dust and the three experimental dusts indicated that particle size did not appreciably affect control.

Dogger (J. R.). **Solutions of Insecticides in an Isoparaffinic Oil for Cotton Insect Control.**—*J. econ. Ent.* **48** no. 4 pp. 422–424, 7 refs. Menasha, Wis., 1955.

Since the use of oil solutions instead of water emulsions would be very convenient in spraying cotton for the control of insect pests, and an isoparaffinic oil known as HFA No. 1 or Soltrol 180 has been shown to be virtually non-phytotoxic [*cf. R.A.E.*, A **42** 288], solutions of insecticides in this oil were tested in Oklahoma in 1951–52. In 1951, a spray of 4 lb. toxaphene in 10 U.S. gals. Soltrol 180 per acre, applied when the squares

were beginning to form, caused severe scorching, but this was apparently due to the toxaphene in oil solution, since later applications of the oil alone were harmless and the toxaphene solution mixed (without an emulsifier) with an equal quantity of water caused only slight scorching when 10 U.S. gals. of the mixture was applied per acre. Injury by the boll weevil [*Anthonomus grandis* Boh.] and the bollworm [*Heliothis zea* (Boddie)] was slightly higher for the water mixture than for the usual toxaphene emulsion spray when both were applied six times between 25th June and 30th July, but not significantly so, and the yield was slightly higher. A solution of 1 lb. aldrin per 10 U.S. gals. Soltrol 180, applied at 8 U.S. gals. per acre in August, had no phytotoxic effects.

In 1952, solutions of 0·33 lb. DDT with 0·13 lb. dieldrin, of 0·33 lb. heptachlor and of 0·166 lb. endrin per U.S. gal. Soltrol 180 were applied at 2–4 U.S. gals. per acre, depending on the size of the plants, at weekly intervals from 23rd June, a week after squares had formed. The heptachlor solution caused slight scorching, but the others showed no phytotoxicity, gave good and approximately equal reductions in the percentage of squares punctured by *A. grandis* and of squares and bolls injured by *H. zea*, and resulted in yields of 532 and 360 lb. lint per acre, respectively. The heptachlor solution caused less reduction in injury and resulted in a yield of 259 lb. lint, as compared with 144 lb. for no treatment.

Carter (R. H.). **Status of Analytical Methods with Respect to the Determination of Minimal Quantities of Insecticides.**—*J. econ. Ent.* **48** no. 4 pp. 424–425, 1 ref. Menasha, Wis., 1955.

This paper comprises a brief discussion of the principles and procedures involved in the determination of insecticide residues on or in plant products. It is concluded that residues of most of the insecticides now used on agricultural crops can be determined at the accepted tolerance levels and that a combination of two or more methods, perhaps including bioassay, gives the most reliable results.

Horber (E.). **Oviposition Preference of *Meromyza americana* Fitch for different Small Grain Varieties under Greenhouse Conditions.**—*J. econ. Ent.* **48** no. 4 pp. 426–430, 18 refs. Menasha, Wis., 1955.

Details are given of five tests carried out in the greenhouse in Kansas on the oviposition preferences of the Chloropid, *Meromyza americana* Fitch, which is injurious to cereals in the United States [*cf. R.A.E.*, A **26** 121]. In the first, the ovipositing females were offered a choice of ten varieties of wheat, one of rye, two of barley and three of oats. Most eggs were laid on eight of the wheat varieties and rye, significantly fewer on barley and none (with a single exception) on oats. In the next three tests, the Harvest Queen variety of wheat was significantly less attractive than others, and in the last two, it was found that the growth stage of the plants and the colour of the light reflected from them (white, yellow, red or blue) influenced the attractiveness of preferred wheat varieties.

Muma (M. H.). **Factors contributing to the natural Control of *Citrus* Insects and Mites in Florida.**—*J. econ. Ent.* **48** no. 4 pp. 432–438, 12 graphs, 21 refs. Menasha, Wis., 1955.

A survey was made in 1952–54 of the natural enemies of the principal arthropod pests of *Citrus* in Florida. The pests concerned are *Lepidosaphes beckii* (Newm.), which is present in almost every grove, *Chrysomphalus ficus* Ashm. (*aonidum*, auct.), which occurs in about 60 per cent. of them,

Phyllocoptruta oleivora (Ashm.) and *Metatetranychus citri* (McG.), which occur in 66 and 60 per cent., respectively, and *Eotetranychus sexmaculatus* (Ril.), which is sometimes numerous.

L. beckii was attacked mainly by two fungi (*Hirsutella besseyi* and *Myiophagus* sp.), predacious mites of the genus *Typhlodromus*, particularly *T. peregrinus* Muma, and the predacious thrips, *Aleurodothrips fasciapennis* (Franklin), and also by the Coccinellids, *Microweisea coccidivora* (Ashm.) and *Chilocorus stigma* Say, and the parasites, *Aspidiotiphagus citrinus* (Craw) and *A. lounsburyi* (Berl. & Paoli). Control is highest during the summer rainy season, when the fungi are effective, but is not equal to that given by insecticides. *Chrysomphalus ficus* was well controlled by parasites, of which *Pseudhomalopoda prima* Gir., *Prospaltella aurantii* (How.), *A. lounsburyi* and *A. citrinus* were common; fungi and predators were of secondary importance. Fungi afforded good control of *Phyllocoptruta oleivora* and *Metatetranychus citri* in late summer and autumn, a species tentatively identified as *Hirsutella thompsonii* attacking the former and *Entomophthora* sp. the latter. *P. oleivora* was also attacked by *Coniopteryx vicina* Hagen, and *M. citri* by *Chrysopa lateralis* (Guér.), but these predators were much less effective. Natural control of the mites was not comparable with that given by acaricides, except during periods of high fungus density. *Eotetranychus sexmaculatus* was preyed upon by *Typhlodromus floridanus* Muma, *Stethorus utilis* (Horn) and *Scolothrips sexmaculatus* (Perg.), and a high degree of control was reached in 1953–54, when infestation was light. Natural control of this mite is usually adequate after warm winters, but not after cold ones.

Fredericksen (C. F.) & Lilly (J. H.). **Measuring Wireworm Reactions to Soil Insecticides by tagging with radioactive Cobalt.**—*J. econ. Ent.* **48** no. 4 pp. 438–442, 6 figs., 4 refs. Menasha, Wis., 1955.

In the experiments described, boxes 10 ins. wide, 20 ins. long and 8 ins. deep were filled with 50 lb. untreated soil or soil of which that at one end had been mixed with aldrin, dieldrin, heptachlor or lindane [almost pure γ BHC] at a rate equivalent to 5 lb. per acre. Wireworms of the genus *Melanotus*, collected in North Carolina, were tagged with radioactive cobalt (^{60}Co) by having a small piece of cobalt wire with an initial activity of about 0·07 millicurie cemented to the dorsal surface of the caudal segment [*cf. R.A.E.*, A **41** 374], and one was placed on the soil in each box and allowed to enter it at will. The subsequent vertical and horizontal positions of the wireworms were determined by means of a Geiger-Müller counter over a period of four days, and the wireworms were then freed from their tags and kept in tins for further observation.

The results showed that movement of the insects was greatest in untreated soil and that soil treatment with aldrin or BHC resulted in the greatest reduction of movement, and treatment with dieldrin in the least. All the wireworms that entered treated soil and stayed in it were dead or moribund after four days, so that all the insecticides were toxic to them, and all from the boxes containing treated soil were dead two weeks later, even though they had not entered the treated areas, so that there must have been some fumigant effect. The wireworms in untreated soil survived normally.

Wilson (J. W.). **Control of the Corn Earworm in Florida.**—*J. econ. Ent.* **48** no. 4 pp. 442–444, 1 fig. Menasha, Wis., 1955.

In Florida, sweet maize is grown largely for marketing fresh, so that a high degree of insect control is necessary. About 75 per cent. of the

commercial acreage is in the southern, 18 per cent. in the central and 4 per cent. in the northern third of the peninsular part of the State, and the three areas have different crop seasons. In the southern area, the maize is sown between early autumn and spring and harvested from mid-October to the beginning of June. *Euxesta stigmatias* Lw. usually requires control in both late autumn and early spring and *Heliothis zea* (Boddie) (*armigera*, auct.) becomes abundant and difficult to control during the spring. Dusts of 10 per cent. DDT are applied six times by growers at two-day intervals, or, if *E. stigmatias* is numerous, mixed dusts of DDT with parathion or chlordane are used, all from aeroplanes or ground equipment. When *Heliothis* is abundant, these dusts are applied up to 12–14 times at intervals of 1–2 days. A DDT emulsion spray applied from the ground is also used, and as *Helminthosporium turcicum* and *H. maydis* cause serious blight diseases, fungicides are added to it, except when the size of the *Heliothis* population requires the addition of mineral oil, with which they are not compatible. After about 15th May, *Heliothis* populations are usually high, and control is frequently unsatisfactory by all methods.

In the central area, most of the sweet maize is sown to mature in late April, May and June, and *H. zea* requires control. DDT dusts are applied at intervals of 1–2 days from ground equipment or aeroplanes, and low egg counts in 1954 suggest that large amounts of insecticide have been applied unnecessarily on the peat-soil areas. On mineral soils, control was satisfactory before 15th May, when populations were low, but not later, when they were high. In the north, harvest begins 2–3 weeks later than in the central area, and *Heliothis* populations are reported to be high. Dusting or spraying is carried out with ground equipment, but frequently not continued through the silking season, with the result that control is unsatisfactory.

Dean (H. A.). **Factors affecting biological Control of Scale Insects on Texas** *Citrus*.—*J. econ. Ent.* **48** no. 4 pp. 444–447, 8 refs. Menasha, Wis., 1955.

Little was known of the natural enemies of the Coccids that infest *Citrus* in the lower Rio Grande Valley of Texas up to about 1950, but as it was desired to apply dusts for the control of mites [*cf. R.A.E.*, A **41** 206] without causing increases in scale populations, surveys were carried out. The results are here discussed, the Coccids being considered in order of decreasing relative importance in the area.

The parasites, *Aphytis* A and *A. chrysomphali* (Merc.) [*cf.* **39** 235], were the most important of the natural enemies of *Aonidiella aurantii* (Mask.), the former, which was not known to be present before 1949, being much the more numerous in samples taken from October 1953 to October 1954. *Aphytis mytilaspidis* (LeB.) was of little importance. *Prospaltella perniciosi* Tower and the red-scale strain of *Comperiella bifasciata* How. [*cf.* **39** 182] were released in a grove near Mercedes in September 1955, but have not been recovered. The predators observed included *Chilocorus cacti* (L.), which usually increases during periods of high scale populations, and unidentified species of *Cybocephalus* and *Microweisea*.

Aphytis proclia (Wlk.) was the only parasite reared from *Parlatoria pergandii* Comst. and is considered to be its principal natural enemy. Some control was afforded by predacious mites, including *Typhlodromus* sp., and a species of *Cybocephalus* showed a preference for this above other Diaspines.

Lepidosaphes gloverii (Pack.) was injurious in three localities in 1951 but not in 1952, when it was apparently heavily parasitised by *Prospaltella*

elongata Doz. *L. beckii* (Newm.) was parasitised by *Aspidiotiphagus citrinus* (Craw) and a species of *Aphytis*, believed to be *Aphytis* A. About 1,500 *Aphytis* X [*cf.* **44** 132] were liberated in two groves in July 1952, and some evidence of establishment was obtained in 1953, though adults were not recovered. *Chrysomphalus ficus* Ashm. (*aonidum*, auct.) was abundant before the low temperatures of early 1951, but rare afterwards, and its parasites were not investigated.

Coccus hesperidum L. was numerous in a few groves in 1951–52 and was always attended by ants, of which *Crematogaster laeviuscula* Mayr and *Solenopsis geminata* (F.) were the commonest; where ants were controlled, the scale was heavily attacked by parasites, of which *Coccophagus lycimnia* (Wlk.) was the most important. Other primary parasites of the scale observed included *C. fraternus* How. (*fuscipes* How.), *Aneristus youngi* Gir., *Aphycus eriococci* Timb., *A. maculipes* How. and *A. flavus* How. *Aphycus* C from China, *A. luteolus* Timb. and *C. eleaphilus* Silv. from Eritrea [*cf.* **44** 54] were released in March 1954, and the first of them was recovered six months later.

Neunzig (H. H.) & Gyrisco (G. G.). **Some Insects injurious to Birdsfoot Trefoil in New York.**—*J. econ. Ent.* **48** no. 4 pp. 447–450, 6 refs. Menasha, Wis., 1955.

Lotus corniculatus has recently become of potential importance as a perennial forage crop in the United States, and as little was known of the insects associated with it, investigations were made in New York. A list is given of the insects found, with indications of those that were injurious. Of the latter, *Philaenus leucophthalmus* (L.), which caused stunting and rosetting of the terminals, was the most important. *Macrosiphum pisum* (Harris) was present in moderate numbers in spring, but caused no noticeable injury, though a high population would probably weaken the plants. *Empoasca fabae* (Harris) caused severe damage in a few fields that had not been mown in spring, but other Jassids caused no apparent injury. *Adelphocoris lineolatus* (Goeze), *A. rapidus* (Say), *Lygus lineolaris* (P. de B.) and *Euschistus variolarius* (P. de B.) all reduced the seed crop. Of the Orthoptera, *Melanoplus femur-rubrum* (Deg.) and *M. bivittatus* (Say) were the most harmful, but *Acheta assimilis* (F.) and *Nemobius fasciatus fasciatus* (Deg.) damaged the seed pods in early September. The Nitidulid, *Brachypterolus pulicarius* (L.) was injurious to the florets, and *Tortrix* (*Archips*) *rosaceana* (Harris), *T. pallorana* Rob., *Eulia* (*T.*) *velutinana* (Wlk.) and *Sparganothis sulphurana* (F.) damaged the terminal growth by webbing the upper leaves together and feeding in the shelters formed. *Bruchophagus gibbus* (Boh.) destroyed 1–2 per cent. of the seed in most fields.

Fulton (R. A.), Smith (F. F.) & Gelardo (R. P.). **Respiratory Protective Devices for agricultural Use.**—*J. econ. Ent.* **48** no. 4 pp. 457–459. Menasha, Wis., 1955.

Methods are described for testing the efficiency of respirators, designed to provide protection from dusts, mists and low vapour concentrations of insecticides during field application, and gas masks, for use when preparing insecticides in close or inadequately ventilated spaces or when applying them in closed spaces such as greenhouses. Air was pumped from a dusting or spraying chamber through the respirator cartridge or gas-mask canister to a test chamber, in which Aphids and two-spotted spider mites [*Tetranychus telarius* (L.)] on leaves were used for the bioassay of TEPP [tetraethyl pyrophosphate] and parathion; chemical methods were also used

for the determination of parathion and chlorinated hydrocarbons. The results are given of typical tests with sprays of TEPP and demeton [diethyl 2-(ethylmercapto)ethyl thiophosphate], dusts of parathion, aldrin and chlordane and dusts and sprays of dieldrin, and commercially available respirators and gas-mask canisters found to give adequate protection against different insecticides are listed.

King (K. M.), Forbes (A. R.), Finlayson (D. G.), Fulton (H. G.) & Howitt (A. J.). **Co-ordinated Experiments on chemical Control of Root Maggots in Rutabagas in British Columbia and Washington, 1953.** —*J. econ. Ent.* **48** no. 4 pp. 470–473, 2 refs. Menasha, Wis., 1955.

The following is based on the authors' summary. Replicated experiments on the control of *Hylemyia* spp. on swedes, carried out under a common plan at five places in British Columbia and one in Washington in 1953, confirmed a previous finding that highly effective control is given under a wide range of conditions by heptachlor and aldrin [*cf. R.A.E.*, A **43** 240]. The most important species at all the places was *H. brassicae* (Bch.), but *H. floralis* (Fall.) also occurred during August and September at one in British Columbia. Several methods of application were tested. By the band method, 1 lb. toxicant per 3,000 ft. of row was applied as a 2·5 per cent. dust raked in to a depth of one inch in a ten-inch band, down the middle of which the seeds were then sown. By the spray method, two applications were made, the first just after an early thinning and the second as late as the crop growth permitted the use of power sprayers; at each application 0·3 lb. heptachlor or 0·5 lb. aldrin per 3,000 ft. of row was applied in about 40 U.S. gals. water. The furrow method, by which a 2·5 per cent. dust was placed in the planting furrow with the seed, was effective at half the rate used by the band method, but resulted in serious reduction of stand in two of the experiments. Seed treatments with dieldrin showed no promise.

Chandler (S. C.). **Biological Studies of Peach Catfacing Insects in Illinois.**—*J. econ. Ent.* **48** no. 4 pp. 473–475, 1 fig., 3 refs. Menasha, Wis., 1955.

In further investigations in 1953–54 in Illinois on the insects responsible for the injury to peach fruits known as cat-facing [*cf. R.A.E.*, A **33** 316], jarring records were made in 26 orchards to determine the order of occurrence of the insects, and cage tests were carried out on the type of injury caused by each, their relative importance and the stage of fruit development at which the attack occurs. The jarring records showed that *Lygus lineolaris* (P. de B.) (*oblineatus* (Say)) [*cf. loc. cit.*] was the first to appear each season, occurring first during the pink stage of bud development and reaching a maximum at late bloom or petal-fall. Pentatomids appeared at the early-bloom stage and reached a maximum at petal-fall or when the sepals were separating, and *Conotrachelus nenuphar* (Hbst.) appeared at full bloom and was most numerous at sepal-fall. The Pentatomids used in the cage tests were jarred from the trees or swept from lucerne in their neighbourhood and comprised mainly *Euschistus servus* (Say), *E. variolarius* (P. de B.), *E. tristigmus* (Say), *Podisus maculiventris* (Say) and *Thyanta custator* (F.). The injury caused by *L. lineolaris* was indistinguishable from that due to them, and that caused by *Conotrachelus* was similar, but usually affected a smaller area; needle pricks in young fruits resulted in injuries similar to those made by *Conotrachelus*. The arboreal Pentatomid, *Brochymena quadripustulata* (F.), was tested separately to determine whether it produced

the typical cat-facing injury and did not do so in either season. Typical injury was caused by insects feeding as early as the flowering period and as late as three weeks after the sepals had fallen, but the damage was mostly caused between petal-fall and sepal-fall.

Ritcher (P. O.) & Morrison (H. E.). *Aphodius pardalis* **Lec. A new Turf Pest.**—*J. econ. Ent.* **48** no. 4 p. 476, 4 refs. Menasha, Wis., 1955.

Larvae found infesting turf on golf fairways at Eugene, Oregon, in April 1954 gave rise to adults identified as *Aphodius pardalis* Lec. Their abundance varied greatly, but reached 240–644 per sq. ft. in some areas. On 28th April, they were nearly full-grown and about half were just below the sod and others in cells 0·25–3 ins. deep. By 10th May, after heavy watering, the turf was recovering and most of the larvae in some areas had descended to depths of 1–7 ins. to pupate. Pupae were observed on 4th June and newly emerged adults on 14th June.

Mulla (M. S.) & Madsen (H. F.). **A new Leafhopper attacking Prunes in California.**—*J. econ. Ent.* **48** no. 4 p. 476, 3 refs. Menasha, Wis., 1955.

During investigations on *Typhlocyba prunicola* Edw. in prune orchards in California in 1953 [*cf. R.A.E.*, A **38** 70], a closely related species identified as *T. quercus* (F.) was also observed attacking the trees. This Cicadellid is known in Europe, and it has been recorded from British Columbia (on cherry), though not previously from the United States. In observations on its bionomics, *T. quercus* was found to have one generation a year. The eggs were mostly laid in June–August under the bark of wood 2–5 years old and overwintered. French prune was the preferred food-plant of both species, and populations of both were relatively low on Imperial prune. *T. quercus* was also not numerous on sweet cherry, but the injury to the leaves was rather severe. *Anagrus epos* Gir. was reared from a few eggs of *T. quercus* but was more effective against *T. prunicola*, and *A. armatus nigriceps* Gir. was obtained from the eggs of *T. prunicola* but not those of *T. quercus*. The population of *T. quercus* reached its peak 3–4 weeks after that of *T. prunicola*, which complicates control.

Gaines (R. C.). **Effect on beneficial Insects of three Insecticide Mixtures applied for Cotton-insect Control in 1954.**—*J. econ. Ent.* **48** no. 4 pp. 477–478, 1 ref. Menasha, Wis., 1955.

In further observations on the effect of insecticides on insect predators in cotton fields [*cf. R.A.E.*, A **43** 220], dusts of toxaphene or of DDT with dieldrin or BHC, all with sulphur, were applied six times by aeroplane and twice by tractor duster at about 11–12·5 lb. per acre to three fields between 15th July and 24th August. Counts of the numbers caught at weekly intervals from 14th June to 16th August, the results of which are given in a table, showed that after the third application, the population of beneficial insects and spiders was practically eliminated.

Moore (A. D.). *Ips confusus* (Lec.) Adults infected with Nematodes.—*J. econ. Ent.* **48** no. 4 p. 478. Menasha, Wis., 1955.

In the course of studies in California on the toxicity of insecticides to *Ips confusus* (Lec.), many adults of this Scolytid were found to be infested

with nematodes identified as *Aphelenchulus* sp. (near *A. reversus*) and *Aphelenchoides* sp. As natural mortality of the beetles was high, living and dead examples of both sexes that had not been treated with insecticides were examined to determine the incidence of attack. It was found that 21 per cent. of all the beetles examined were infested with *Aphelenchulus* and 83 per cent. with *Aphelenchoides*, most of the former also containing *Aphelenchoides*. Only adults of *Aphelenchulus* were present, and they numbered 1–12 in the body cavities of infested beetles, whereas only immature stages of *Aphelenchoides* were observed, and they occurred in groups of 10–100 or more in the rectum, free in the abdominal cavity or under the elytra. As 18 and 17 per cent. of the dead males and females and 32 and 18 per cent. of the living males and females contained *Aphelenchulus* and 77 and 73 per cent. of the dead males and females and 88 and 90 per cent. of the surviving males and females contained *Aphelenchoides*, it is concluded that the infestation had no effect on mortality and could be disregarded in analysing the results of toxicity studies.

Kennard (W. C.) & Spencer (J. L.). **A mechanical Insect Collector with high Maneuverability.**—*J. econ. Ent.* **48** no. 4 pp. 478–479, 2 figs., 2 refs. Menasha, Wis., 1955.

The mechanical insect collector described was devised for use on trees. A converted hand-type electric vacuum cleaner hung on the shoulder provides suction through a long tube; this ends in a funnel, which is fitted with a coarse net across the outer end and a fine net across the inner one and is supported on a light pole held in the hand. After collection, the insects are anaesthetised with ethyl acetate before the motor is switched off and the insects adhering to the outer and inner nets are dropped into separate killing jars. The apparatus provides undamaged specimens, including immature forms and small insects, and can be operated from commercial electric power, a portable generator or a battery.

Osmun (J. V.) & Pfendler (D. C.). **A Device for sub-slab Pressure Injection of Insecticides.**—*J. econ. Ent.* **48** no. 4 pp. 479–480. 1 fig. Menasha, Wis., 1955.

The authors describe an apparatus for injecting liquids and gases under pressure into the soil beneath such barriers as concrete slabs for the control of termites or other purposes. It consists essentially of a nozzle fitted with an expanding pliable collar, attached to the hose line of a conventional spray apparatus or gas cylinder. The nozzle is inserted through a hole drilled in the concrete, and the collar is expanded to fit the hole closely and prevent leakage. After treatment, the nozzle is removed by releasing the collar.

Hornstein (I.), Sullivan (W. N.) & Tsao (Ching-hsi). **Residual Effectiveness of Mixtures of organic Phosphorus Insecticides with Chlorinated Terphenyls.**—*J. econ. Ent.* **48** no. 4 pp. 482–483, 7 refs. Menasha, Wis., 1955.

It has been shown that the effectiveness of deposits of relatively volatile chlorinated-hydrocarbon insecticides can be increased by the addition of Aroclor 5460 (an isomeric mixture of chlorinated terphenyls), and suitable methods of applying the mixtures have been described [*R.A.E.*, A **44** 117, etc.]. The results are here given of an evaluation of the effect of Aroclor on deposits of phosphorus insecticides, for which preliminary tests

showed it to be a good solvent. These insecticides were parathion, Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl thiophosphate], malathion, Bayer L 13/59 [dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate], dimethyl 2,2-dichlorovinyl phosphate, and diethyl 2,2-dichlorovinyl phosphate. They were applied to glass plates in solution in methyl ethyl ketone at 25 mg. insecticide with 0, 25 or 100 mg. Aroclor per sq. ft. The treated plates were stored vertically in a rack with good ventilation, and test insects were exposed on them for 60 minutes.

The greatest ages at which deposits gave 100 per cent. kill of adults of *Musca domestica* L. when combined with 0, 25 and 100 mg. Aroclor were 10, 30 and 30 days for parathion, two hours, two hours and 30 days for Diazinon, and two hours, 4–5 days and 4–5 days for Bayer L 13/59. The highest mortalities given by dimethyl 2,2-dichlorovinyl phosphate and diethyl 2,2-dichlorovinyl phosphate alone were 50 and 33 per cent., respectively, after two hours, but both gave 100 per cent. kill after 60 days with the Aroclor at either strength. Malathion gave 100 per cent. kill after 4–5 days without Aroclor and after ten days with 25 mg., but the highest mortality given in combination with 100 mg. was 37 per cent. after two hours. Percentage kills of large nymphs and adults of *Periplaneta americana* (L.) given by the insecticides alone and with 25 and 100 mg. Aroclor were 100, 100 and 100 after ten days and 0, 48 and 97 after 30 days for parathion, 100, 100 and 96 after two hours and 0, 2 and 26 per cent. after 4–5 days for Diazinon, 100, 100 and 100 after 4–5 days and 39, 65 and 100 after ten days for Bayer L 13/59, and 79, 90 and 37 after two hours for malathion. The dimethyl and diethyl 2,2-dichlorovinyl phosphates both gave no mortality alone, 100 per cent. after ten days with 25 mg. Aroclor, and 100 per cent. after 60 days with 100 mg. Similar results were obtained in tests in which adults of *Tribolium confusum* Duv. were exposed 4–5 days or more after the deposits were applied, except that Bayer L 13/59 was almost completely non-toxic. Dimethyl 2,2-dichlorovinyl phosphate was remarkable for the rapid knockdown it gave.

The effectiveness of a deposit containing Aroclor is maintained by diffusion of fresh toxicant from the body of the deposit to the surface. The lower the vapour pressure of an insecticide, the more slowly it is replaced at the surface and the greater the fraction that may decompose. If the ratio of Aroclor to insecticide is progressively increased, a dilution will be reached at which the vapour pressure and surface concentration of the insecticide are too low for the deposit to be effective. This dilution is a function of the vapour pressure of the insecticide and its inherent toxicity. It was reached in this work with malathion, which has the lowest vapour pressure and toxicity of the compounds tested. Conversely, the higher the vapour pressure of the insecticide and the greater its inherent toxicity, the more marked is the increase in effectiveness of the combination. The two dichlorovinyl phosphates were the most volatile compounds tested. In preliminary tests of the toxicity to *M. domestica* of deposits that had been applied to pine foliage outdoors, malathion was more effective alone than in 1 : 4 ratio with Aroclor, but Diazinon in 1 : 4 ratio gave 92 and 77 per cent. kill after 30 and 60 days, whereas it was ineffective after four days alone or in 1 : 1 ratio.

Richardson (H. H.). **Ethylene Dibromide and Methyl Bromide Fumigation of Apples infested with Apple Maggots.**—*J. econ. Ent.* **48** no. 4 pp. 483–484, 8 refs. Menasha, Wis., 1955.

Small-scale tests were made in New Jersey in 1953 to compare ethylene dibromide with methyl bromide [*cf. R.A.E.*, A **29** 364] for the control of

larvae of *Rhagoletis pomonella* (Walsh) in apples. Exposure to the fumigants was for two hours with continuous fan circulation at normal atmospheric pressure and temperatures near 70–87°F., and treated and untreated apples were kept at about 75–85°F. for about 50 days and examined for pupae at intervals of a week or less, or the fruits were cut and examined for living or dead larvae after 7 and 50 days. Untreated fruits gave rise to 0·23–2·9 pupae each. Ethylene dibromide gave complete kill in three tests at 0·25 lb. per 1,000 cu. ft. at temperatures near 70–76°F. and about 98·6 per cent. estimated mortality of 432 larvae at 0·125 lb. at 87°, and had no adverse effect on the apples. Methyl bromide gave complete kill in five tests at doses of 1·25–2 lb. per 1,000 cu. ft. at about 70°F. and in two at 1–1·25 lb. at 87°, and 99·6 per cent. estimated mortality of 324 larvae at 0·625 lb. at 87°. It appeared that ethylene dibromide is as effective against *R. pomonella* as it is against other fruit-flies [*cf.* **40** 74, 352; **43** 320] and that methyl bromide is somewhat less toxic.

Kantack (E. J.). **Carbowax as a Carrier of Systemic Insecticides for treating Wheat Seed.**—*J. econ. Ent.* **48** no. 4 p. 486. Menasha, Wis., 1955.

In the course of investigations on the control of *Aceria tulipae* (Keifer) on young wheat plants by seed coatings incorporating a systemic toxicant, carried out in Kansas in 1954, Carbowax 6000, a water-soluble polyethylene glycol with a melting point of 60–63°C. [140–145·4°F.], was selected as the most promising carrier after tests of several other materials, including Carbowax 4000, a similar glycol with a melting point of 53–56°C. [127·4–132·8°F.].

Carbowax 4000 had no effect on germination at a rate of 12 lb. per bushel seed when used alone, but reduced it, usually in proportion to the concentration of toxicant, when Chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl thiophosphate], demeton [diethyl 2-(ethylmercapto)ethyl thiophosphate], Meta-Systox [the dimethoxy homologue of demeton], schradan, Am. Cyanamid 12008 [O,O-diethyl S-isopropylmercaptomethyl dithiophosphate] or Am. Cyanamid 12009 [O,O-diethyl S-n-propylmercaptomethyl dithiophosphate] was added. The reduction appeared to be greater when water was added to the formulation. Good germination was generally obtained when 0·5 lb. toxicant or less was blended with 4 lb. Carbowax 6000 per bushel seed. When the six toxicants were applied by seed coating and by soil drenching to give the same rates per acre, the seed treatment generally gave greater reductions in mite populations during the first 4½ weeks but was less effective than the drench after 4½–7 weeks; neither treatment gave substantial reductions after more than seven weeks. Seed coatings gave effective control almost immediately the plants appeared, whereas soil drenches did not reduce mite populations until a week after application. However, the latter were the more effective during periods of rapid plant growth, probably because the expanding root systems could obtain more of the toxicant from the soil, and mite counts indicated that the dilution factor of the toxicant in the plants was less by the soil drench method than by seed treatment during such periods.

Wolcott (G. N.) & Pérez (M.). **Control of the Sweet Potatoweevil in Puerto Rico.**—*J. econ. Ent.* **48** no. 4 pp. 486–487, 3 refs. Menasha, Wis., 1955.

Infestation of sweet potatoes in Porto Rico by *Cylas formicarius elegantulus* (Summers) is so severe that their commercial production is

largely prevented and export to the United States was until recently prohibited. As aldrin showed no toxicity to the plants in preliminary experiments, it was tested against the weevil in 1952, on a variety that is very susceptible to attack. Emulsion concentrates were used, and the three treatments tested comprised spraying the ground on 14th January, this and dipping the planting material before planting on 25th February, and these two measures and spraying the plants four times at monthly intervals from 21st April. Harvesting was begun on 5th August, six weeks late, owing to unseasonable rainfall, and 61, 90 and 98 per cent., respectively, of the sweet potatoes from plots receiving the three treatments were uninjured by the weevil, as compared with 38 per cent. for no treatment. The sweet potatoes from the plots receiving the third treatment had a very good appearance and flavour, and the yield was more than twice that from the untreated plot. Further tests indicated that all three measures were necessary for the elimination of *Cylas* and that aldrin, dieldrin and heptachlor were almost equally effective and DDT and lindane [γ BHC] less so.

CARTER (Walter). **Notes on some Mealybugs (Coccidae) of economic Importance in Ceylon.**—*FAO Plant Prot. Bull.* **4** no. 4 pp. 49-52, 4 figs., 4 refs. Rome, 1956.

In view of confirmation of the presence of a strain of swollen-shoot virus on cacao in Ceylon, the importance of mealybugs as vectors of it was investigated [*cf. R.A.E.*, A **42** 261]. In laboratory tests with the three species found on cacao, *Planococcus* (*Pseudococcus*) *lilacinus* (Ckll.), which was by far the commonest, and *P.* (*P.*) *citri* (Risso) transmitted the virus, symptoms of vein-clearing appearing about two months after the germination of the infected beans, but *Ferrisiana* (*Ferrisia*) *virgata* (Ckll.), which is associated with the flower pads on the trunks, gave inconclusive results. The disease appears to be of little importance, but control is desirable.

Severe wilting of pineapple planted on recently cleared land near Colombo was shown to be due to feeding by *Dysmicoccus* (*Pseudococcus*) *brevipes* (Ckll.), a mealybug that causes this condition throughout the tropics [*cf.* **30** 521]. Fumigation of planting material is recommended for control. *D. brevipes* also caused some green spotting of pineapple [*cf.* **21** 64], but the damage was not of economic importance. The symbionts of the mealybug in Ceylon did not include the rod-shaped form [*cf.* **30** 522].

A curling of the terminal and lateral shoots of seedling kapok [*Ceiba pentandra*] was found to be due to feeding by an unidentified species of *Pseudococcus* that produces an egg-mass enclosed in a parchment-like sac. Normal growth developed when the mealybug was controlled by spraying with malathion.

SPENCER (J. L.), CABANILLAS (E.) & KENNARD (W. C.). **Incidence and Control of the *Citrus* Hesperiid in Puerto Rico.**—*FAO Plant Prot. Bull.* **4** no. 5 pp. 61-63, 2 figs., 1 ref. Rome, 1956.

An outbreak of *Achlyodes mithridates minor* Comst.* on *Citrus* occurred in Porto Rico in the autumn of 1955, at the end of the rainy season, the infestation being especially severe in the north-west and along the north coast, where leaves were rolled on almost 80 per cent. of the trees. Random

* This Hesperiid is cited by the authors as *Achylodes papinianus minor* Comstock (syn. *Eantis thraso* Hubner), but we are informed by Brigadier W. H. Evans of the British Museum that, in his opinion, *Urbanus thraso* Hübner, *Hesperia papinianus* Poey and *Achlyodes papinianus minor* Comstock are all subspecies of *A.* (*Hesperia*) *mithridates* (F.).—*Ed.*

counts showed an average of 9·3 larvae and pupae per tree. The neglected condition of the *Citrus* plantings in the island allows populations of *A. m. minor* to build up periodically, but a single application of 1 lb. wettable DDT per 50 U.S. gals. water, with a wetting agent, gave good control in tests.

Miller (P. R.). **Plant Disease Situation in the United States.**—*FAO Plant Prot. Bull.* **4** no. 5 pp. 69–71, 2 figs. Rome, 1956.

Peach mosaic is a disease of importance in southern California and other parts of the United States. In investigations on possible arthropod vectors of the causal virus [*cf. R.A.E.*, A **36** 79], over 150 insects and mites were tested, but the only one to effect transmission was a species of *Eriophyes*, probably undescribed. This mite was first collected near Riverside, California, in April 1955 on infected peach trees. It was observed only in the buds and apparently dispersed when the basal bud scales began to separate. The densest populations occurred in retarded buds in April, and the mite was found in late summer only in retarded and stunted buds, which are characteristic of trees affected by peach mosaic. It was also observed on *Prunus angustifolia*, *P. hortulana*, *P. munsoniana*, *P. mexicana* and *P. cerasifera*, under the scales of dormant and retarded buds and reproducing in leaf axils and among the rudimentary leaves of expanding buds on vigorously growing shoots. In the transmission tests, healthy peach seedlings were infected by the feeding of unseparated adult and immature mites, 16 of the positive batches originating from infected peach and one from *P. hortulana*. The symptoms appeared in 14–100 days, and the identity of the virus was checked by patch bark grafts to further healthy seedlings. The plants that showed symptoms after feeding by the mite were either newly germinated seedlings less than 3 ins. high or year-old plants emerging from dormancy. No symptoms were observed on seedlings 3–12 ins. high, but it was thought that some might develop after dormancy. In subsequent tests, the virus was transmitted by the feeding of a single adult mite. During brief visits to western Colorado, Arizona and New Mexico, the mite was found in infected orchards in all the districts investigated.

Outbreaks and new Records.—*FAO Plant Prot. Bull.* **3** no. 11 pp. 172–173; no. 12 pp. 188–189; **4** no. 2 p. 30; no. 4 p. 58; no. 5 p. 72. Rome, 1955–56.

W. J. Hall reports (p. 172) that *Acceria sheldoni* (Ewing) has recently been found on *Citrus* in Kenya [*cf. R.A.E.*, A **44** 211] and reviews the distribution of this mite. He also states that *Eldana saccharina* Wlk., which is known in other parts of Africa, was recently observed for the first time in Tanganyika, where it caused severe damage to sugar-cane at Arusha.

The U.S. Department of Agriculture states (p. 172) that the *Citrus* blackfly, *Aleurocanthus woglumi* Ashby, was found for the first time in the United States in May 1955, when eggs and pupae were observed on a lime tree at Brownsville, Texas, near the Mexican frontier [*cf.* **44** 235]. An eradication campaign was begun.

It is reported by E. Morales (p. 188) that *Ceratitis capitata* (Wied.) was taken for the first time in Costa Rica in March 1955. Infestation spread rapidly over a large part of the central plateau, and adults were taken in the Provinces of San José, Heredia and Alajuela. Infestation was heavy on peach but moderate on orange and grapefruit. Pods of *Inga* spp. were also attacked. The fruit-fly was not previously known in Central America.

M. Crooke reports (p. 30) the finding of *Ips cembrae* (Heer) breeding on larch in several localities in north-eastern Scotland. This is the first record of this Scolytid in Britain, but it is thought that it may have been introduced with *Ips typographus* (L.), which it resembles, on spruce from Germany in 1946 [*cf.* **37** 7].

W. C. Kennard & J. L. Spencer state (p. 58) that an unidentified thrips of the genus *Frankliniella* was observed causing extensive damage to the unopened buds and expanding flowers of mango in Porto Rico. The eggs were deposited in the buds, and about 31 per cent. of the flowers were injured by the feeding of the nymphs on the developing pollen and floral tissues.

J. A. Whellan reports (p. 58) from Southern Rhodesia that *Latheticus oryzae* Waterh., which had not previously been observed there, was found to be abundant in stored grain near Salisbury and that an unidentified species of *Chilo* was reared from the stems of rice and *Eleusine coracana*.

W. J. Hall states (p. 72) that *Phyllocoptruta oleivora* (Ashm.) was observed in 1955 on *Citrus* in Tanganyika, Kenya and Mauritius; all three countries are believed to be new records for this mite. In Tanganyika, it was at first thought (p. 172) to be *Aceria sheldoni*, which does not occur there.

O'Connor (B. A.). **The Rice Leaf Hopper, *Sogata furcifera kolophon*, Kirkaldy and Rice Yellows.**—*Agric. J. Fiji* **23** no. 3–4 pp. 97–104, 2 refs. Suva, 1952.

Since 1938, when yellowing of the leaves of rice [*cf. R.A.E.*, A **31** 160] was first reported in Fiji, the symptoms have been observed throughout the rice-growing areas, usually 4–12 weeks after transplanting, from the first half of February until late March. Investigations on the condition, the symptoms of which are briefly described, were carried out on Viti Levu in 1948–52. Though it usually occurs on plants growing in stagnant pools or shallow flowing water in fields that are otherwise dry, it was widespread in 1951–52 in fields well covered with water and also in fields of dry rice. Affected plants are almost always infested by large numbers of *Sogata furcifera kolophon* (Kirk.), and, in insectary experiments, symptoms were not produced when insect-free plants were grown in stagnant water, but appeared in all cases when batches of the Delphacid were caged on young transplanted rice plants or those grown from seed. No virus could be transmitted mechanically or by transference of *Sogata* males from affected leaves, and it is concluded that the yellowing is due to the physiological effects of feeding and oviposition by large populations of the insect. Feeding by only small numbers failed to produce symptoms.

In experiments on control in 1948–49, sprays affording 2½–5½ lb. actual DDT per acre resulted in few adults and no nymphs in the seed-beds, but the population built up normally once the crop was transplanted. A 2 per cent. DDT dust and an emulsified solution of about 0·2 per cent. DDT gave almost complete control of adults and nymphs within 24 hours when applied to field crops and kept the plants free from infestation for at least a fortnight. It was not possible to determine the effect on the occurrence of yellows, as symptoms were not present, or only slight, on both untreated and treated plots, but it is recommended that the DDT spray be applied about five weeks after transplanting, when the nymphs of the first generation produced on the plants are becoming adult.

The eggs of *S. f. kolophon* are described, and its bionomics are briefly reviewed. At a mean daily temperature of about 80° F., the eggs hatch in six days. The nymphal stage is completed in 21 days, and the adults

survive for about a week. There is a preoviposition period of two days. A list is given of the parasites and predators known or believed to attack the Delphacid in the field. The only one studied is *Cyrtorhinus vitiensis* Usinger, a Mirid that is fairly numerous in the rice-fields in the early part of the growing season. It is an efficient predator of the eggs in the laboratory but appears to afford little control in the field. It lays its eggs singly in the leaf sheaths or in the midribs, and the nymphs hatch in about a week and become adult in 19–22 days at a daily average temperature of about 80°F. The predator was first found in Fiji in 1948, and it is thought that it may not yet be fully adapted to living in rice-fields.

O'Connor (B. A.). **An introduced Parasite of Noogoora Burr.**—*Agric. J. Fiji* **23** no. 3–4 pp. 105–106. Suva, 1952.

As Noogoora burr [*Xanthium pungens*] fruits throughout the year in Fiji, it was thought that it might be more effectively controlled there by *Euaresta aequalis* Lw., which attacks the fruits of this weed, than it is in Queensland, where these are produced at one season only [*cf. R.A.E.*, A **35** 220]. Adults, puparia and larvae in diapause were therefore collected in Queensland and taken to Fiji in February 1951. Most of the larvae had pupated by 14th April, and the pupal stage averaged 25–26 days. Adult emergence had begun in February, and it reached its peak on 23rd–25th February, continuing until mid-April. Pairing normally occurred 4–5 days after emergence, and the adults survived for 7–8 weeks when honey solution was provided. More than 2,000 adults of both sexes, some of which had previously paired, were liberated near extensive areas of the weed by the Sigatoka River on Viti Levu between 8th February and 7th April. It was not known whether the Trypetid became established, but severe flooding in January 1952, when the vegetation was completely submerged, probably had an adverse effect.

Markkula (M.) & Tinnilä (A.). **Oviposition of the Lesser Clover Leaf Weevil, *Phytonomus nigrirostris* Fabr. (Col., Curculionidae).**—*Ann. ent. fenn.* **21** no. 1 pp. 26–30, 3 figs., 5 refs. Helsinki, 1955.

Hypera (*Phytonomus*) *nigrirostris* (F.) is an important pest of leguminous forage plants, particularly red clover, in Finland. Investigations on its bionomics were begun in 1953, and an account is given of insectary and field observations on oviposition by this weevil carried out in 1954. In the insectary, oviposition began on 20th May and ended on 27th July, six females confined with clover shoots laying an average of 6·1 eggs each per day for 47 days. Of the 1,733 eggs laid, 0·1 per cent. were found in the stipules, 61 per cent. in the lower surface of the leaf and almost 39 per cent. in the upper surface, a few being found on the surface of the leaf. Of 73 eggs inspected in the field, 44 and 21 were in the lower and upper leaf surfaces, respectively, and 8 in the stipules. Of all the eggs deposited in the insectary, 43·1 per cent. were laid singly and the remainder in groups of 2–6.

Nuorteva (P.). **On the Nature of the Plant injuring Salivary Toxins of Insects.**—*Ann. ent. fenn.* **21** no. 1 pp. 33–38, 3 figs., 19 refs. Helsinki, 1955.

The following is substantially the author's summary. An account is given of experiments in which it was shown that papain imbibed from a synthetic

nutrient fluid by *Plesiocoris rugicollis* (Fall.) is transferred in active form to the salivary glands. No such transfer was observed in *Stenodema calcaratum* (Fall.). It is suggested that at least some of the plant-injuring salivary toxins of insects may originate from the host plants and not be produced by the insects. Evidence is adduced in support of this.

Schwenke (W.). **Untersuchungen zum Massenwechsel der Kiefernspanner *Bupalus piniarius* L. und *Semiothisa liturata* Cl. auf vergleichend-biozönotischer Grundlage. II.** [Investigations on the Fluctuation in Numbers of *B. piniarius* and *S. liturata* on a comparative biocoenotic Basis. II.]—*Beitr. Ent.* **4** no. 3–4 pp. 388–451, 2 graphs, 31 refs. Berlin, 1954.

On the basis of the conclusions reached in the first part of this paper [*R.A.E.*, A **41** 337], four pine stands near Berlin resembling one another in age and macroclimate were selected for study, and counts of the pupae of *Bupalus piniarius* (L.) and *Semiothisa liturata* (Cl.) were made in sample areas beneath the crowns of trees in the centre of each in the springs of 1952 and 1953, when populations were normal in size. The stands are described in detail, with special reference to temperature, humidity, precipitation, soil type, the weight of needles on the trees per unit area of ground, which was determined by a method that is described, ground cover, and the insects that might act as predators of either Geometrid.

The numbers of pupae found per sample area of about 60 sq. yards in the four stands in 1952 and (in brackets) 1953 were 28 (12), 114 (32), 36 (14) and 0 (0) for *B. piniarius*, and 33 (7), 75 (12), 40 (8) and 1 (0) for *S. liturata*, respectively, and the corresponding numbers per 100 kg. needles were 12 (5), 46 (19), 20 (8) and less than 1 (in both years) for *B. piniarius* and 14 (3), 30 (5), 22 (5) and less than 1 for *S. liturata*. Of 40 pupae of both species exposed in the last stand, which was the driest and lightest of the four, in the winter of 1951–52, 37 had given rise to adults by June 1952, and experimental rearing of larvae in it gave results similar to those obtained in the other three. It was therefore concluded that the scarcity of pupae in this stand was due to the less dense growth of the trees in it, which afforded less shelter from the wind and so less favourable conditions for the ovipositing females [*cf.* **41** 338], and it was excluded from further consideration. A list is given of the ten species of parasites reared from the pupae collected in the other three stands, showing their frequency. Six of them, the most numerous of which were *Ichneumon nigritarius* Grav., *I. bilunulatus* Grav. and the Tachinid, *Carcelia rutilla* (Rond.), were common to both Geometrids. The parasitism percentages in the three stands in 1952 and (in brackets) 1953 were 14 (33), 10·5 (37·5) and 11 (50) for *B. piniarius*, and were calculated to be 11 (40), 18 (29) and 12 (18) for *S. liturata* on the basis of supplementary counts in August and September 1952, which indicated that pupae of this Geometrid are parasitised by successive generations of the two Ichneumonids and the Eulophid, *Dahlbominus fuscipennis* (Zett.).

Mortality due to predators in 1952, estimated from the numbers of pupae found to have been opened, was 7 per cent. in the first two stands and 4 per cent. in the third for *B. piniarius* and 15 per cent. in all three stands for *S. liturata*, and it appeared to increase with the humidity of the stand, which was in conformity with the greater number of predators found in the humid stands as compared with the drier ones. Pupal mortality due to abiotic factors was estimated at 7 per cent. in the first two stands and

4 per cent. in the third for *B. piniarius* and at 3 per cent. in each stand for *S. liturata*.

The numbers of adults that emerged in the three stands in 1952 per 100 kg. needles, calculated by deducting pupal mortality from the initial pupal population, were 8·6, 37·5 and 15 for *B. piniarius* and 9·4, 20 and 14·5 for *S. liturata*. The sex ratio was about 1:1 in both species, and the average numbers of eggs laid by the females and of those still present in them after death were calculated, on the basis of field-cage investigations, to be 50 and 81, respectively, for *B. piniarius* and 65 and 40 for *S. liturata*. Almost all the females had been fertilised, as shown by the high percentages of eggs that hatched, and the difference in the proportion of eggs deposited is attributed to the unfavourable effects of cool, damp and windy weather during the oviposition period of *B. piniarius*. Abiotic factors were estimated to have caused 62 per cent. mortality of *B. piniarius* and 38 per cent. of *S. liturata* before oviposition was complete, and predators 2 and 6 per cent., respectively.

The numbers of eggs laid per 100 kg. needles in the three stands were estimated to be 204, 891 and 356 for *B. piniarius* and 281, 527 and 430 for *S. liturata*, respectively, and as egg mortality reached only 4 and 2 per cent. for the two species, respectively, the numbers of first-instar larvae per 100 kg. needles in the three stands were estimated at 196, 855 and 342 for *B. piniarius* and 275, 516 and 421 for *S. liturata*. Larval mortality was assessed at 97·5 per cent. for *B. piniarius* and 98·5 per cent. for *S. liturata* in all three stands, and, on the basis of rearing in the field and sampling in the crowns of felled trees, it is estimated that 49 per cent. of this mortality was due to abiotic factors, rainfall being heavy during June and July. The Braconid, *Rogas cantherius* Lyle, was reared from larvae of *S. liturata*, and is calculated to have accounted for 2 per cent. of the mortality, the remaining mortality of both species being caused by predators.

Stobwasser (H.). **Eindringvermögen von Wirkstoffnebel in ein Getreidefeld.** [The Penetration Capacity of an insecticidal Fog into a Cornfield.]—*Anz. Schädlingsk.* **27** pt. 12 pp. 177–178, 1 graph, 3 refs. Berlin, 1954.

Owing to increased infestation of wheat by gall-midges in southern Hanover in 1953, a test designed to ascertain the distance to which an insecticidal fog would penetrate a wheat field was carried out in 1954. A mobile apparatus was used in which a mixture containing 25 per cent. γ BHC was vaporised by heat. The vapour condensed on reaching the air and formed a finely dispersed cloud that was concentrated and driven forward by the draught from a fan. The apparatus was moved slowly from east to west along the south side of the field, which measured about 3·7 acres, the wind blew at 4·5–9 miles per hour from the south-south-west and just over 1·5 lb. γ BHC was applied. Along the east side of the field, wheat grains in gauze bags had been attached at the level of the ears and at 1 ft. above ground to bamboo canes situated at points representing distances of penetration by the fog of about 65–295 ft. After treatment, the seeds were transferred to petri dishes, and batches of 20 adults of *Calandra granaria* (L.) were confined with them. Mortality was low on the first day, but there was a steady increase until the sixth day, when almost complete kill was given by the grains exposed at distances of about 65–230 ft., and only slightly less by those exposed at 295 ft. The grains exposed 1 ft. above ground proved somewhat less toxic at first than those exposed at ear-level, but there was little difference by the sixth day.

Weiser (J.). *Neoaplectana carpocapsae* **n.sp. (Anguillulata, Steinernematinae), nový cizopasník housenek obaleče jablečného,** *Carpocapsa pomonella* **L.** [*N. carpocapsae* sp.n. a new Parasite of the Larvae of the Codling Moth, *Cydia pomonella*.]—*Acta Soc. zool. bohemoslov.* **19** pt. 1 pp. 44–52, 2 figs., 8 refs. Prague, 1955. (With Summaries in Russian and German.)

A nematode found parasitising the overwintering larvae of *Cydia* (*Carpocapsa*) *pomonella* (L.) on apple in north-eastern Bohemia is described as *Neoaplectana carpocapsae*, sp.n. The females are ovoviviparous, and the second stage larvae leave their hosts through the gut. Several hundred males and females occur in a single host, and they do not survive the death of the latter. Infestation occurs while the larvae of *C. pomonella* are constructing their cocoons on the trunk, the nematode larvae being ingested by them together with fragments of bark.

Giunchi (P.). **Contributi alla conoscenza dell'entomofauna dell'erba medica. II. Note morfologiche sugli stadi preimmaginali dell'***Apion pisi* **F.** [Contributions to Knowledge of the Insect Fauna of Lucerne. II. Morphological Notes on the immature Stages of *A. pisi*.]—*Boll. Ist. Ent. Bologna* **20** (1954) pp. 21–28, 6 figs., 5 refs. Bologna, 1955.

In this second part of a series, the author describes the egg, full-fed larva and pupa of *Apion pisi* (F.), which is a serious pest of lucerne in Italy [*cf. R.A.E.*, A **44** 8], and gives a key to the larvae, so far as known, of the Italian species of *Apion*.

Hood (J. D.). **A new** *Chaetanaphothrips* **from Formosa, with a Note on the Banana Thrips.**—*Proc. biol. Soc. Wash.* **67** pp. 215–218, 4 figs. Washington, D.C., 1954.

The banana rust thrips has long been known as *Scirtothrips signipennis* Bagn., but it is here stated that it belongs in the genus *Chaetanaphothrips* and that *C.* (*Anaphothrips*) *orchidii* (Moult.) is an earlier name for it. Specimens were seen from Australia, Fiji, Panama, Trinidad, Brazil, Honduras, Costa Rica and Florida, all taken in the open from various plants, but not from orchids, and also from greenhouses in England, Belgium and France. Two structurally different forms exist, a larger one and a smaller one that is parthenogenetic; both infest banana. Pupation occurs in the soil. A closely related species that rolls the leaves of *Machilus* in Formosa and has been misidentified as *C. orchidii* is described as *C. machili*, sp. n. It pupates on the leaves of the trees.

Papers noticed by Title only.

Mamet (J. R.). **A revised Food-plant Catalogue of the Insects of Mauritius.**—*Bull. Dep. Agric. Mauritius* no. 90, [1 +] 95 pp., 3½ pp. refs. Port Louis, 1955. [*Cf. R.A.E.*, A **40** 32.]

Takahashi (R.). **Insects of Micronesia. Vol. 6 no. 1. Homoptera: Aleyrodidae.**—pp. [3 +] 1–13, 10 figs., 1 map. Essig (E. O.). **Vol. 6 no. 2. Homoptera: Aphididae.**—pp. [3 +] 15–37, 14 figs., 1 map. Drake (C. J.). **Vol. 7 no. 2. Hemiptera: Tingidae.**—pp. [3 +] 101–116, 8 figs., 1 map. Honolulu, Bishop Mus., 1956. [*Cf. R.A.E.*, A **43** 345; **44** 212.]